Coral skeletal proxy records database for the Great Barrier Reef, Australia

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Abstract. The Great Barrier Reef (GBR), Australia, has a long history of palaeoenvironmental coral research. However, it can be logistically difficult to find the relevant research and records, which are often unpublished or exist as "grey literature". This hinders researchers' abilities to efficiently assess the current state of coral core studies on the GBR and thus identify any key knowledge gaps. This study presents the Great Barrier Reef Coral Skeletal Records Database (GBRCD), which compiles 208 records from coral skeletal research conducted since the early 1990s. The database includes records from the Holocene, from $\sim$8000 years ago, to the present day; records are from the northern, central, and southern GBR from inshore and offshore locations. Massive *Porites* spp. coral records comprise the majority (92.5 %) of the database, and the remaining records are from *Acropora*, *Isopora*, or *Cyphastrea* spp. The database includes 78 variables, with Sr/Ca, U/Ca, and Ba/Ca being the most frequently measured. Most records measure data over 10 or more years and are at monthly or lower resolution. The GBRCD is machine readable and easily searchable so that users can find records relevant to their research, e.g. by filtering for site name, time period, or coral type. It is publicly available as comma-separated values (CSV) data and metadata files with entries linked by the unique record ID and as Linked Paleo Data (LiPD) files. The GBRCD is publicly available from the NOAA National Center for Environmental Information World Data Service for Paleoclimatology at https://doi.org/10.25921/hqxk-8h74 (Arzey et al., 2024). The intention is to update the GBRCD annually, depending on the availability of relevant new GBR records or submission of legacy records to the GBRCD for archiving. The collection and curation of existing GBR coral research data provide researchers with the ability to analyse common proxies such as Sr/Ca across multiple locations and/or examine regional to reef-scale trends. The database is also suitable for multi-proxy comparisons and combination or composite analyses to determine overarching changes recorded by the proxies. This database represents the first comprehensive compilation of coral records from the GBR. It enables the investigation of multiple environmental factors via various proxy systems for the GBR, northeastern Australia, and potentially the broader Indo-Pacific region.

1 Introduction

Scleractinian coral skeletons have long been used to reconstruct past changes of reef environments and climates, as well as to understand reef responses to those changes (e.g. Druffel and Griffin, 1993; Webster et al., 2018; Thompson, 2022; Clark et al., 2017; Felis et al., 2014). Foundational to the field are studies on corals from the World Heritage-listed Great Barrier Reef (GBR). Studies on GBR corals have established, for example, the relationships between coral skeletal Sr/Ca and δ^{18}O with sea surface temperature (SST) (Weber and Woodhead, 1969, 1970, 1972; Weber, 1973; McCulloch et al., 1994), coral luminescence with riverine inputs (Isdale, 1984; Boto and Isdale, 1985; Isdale et al., 1998), and coral radiocarbon with oceanographic processes (Druffel and Griffin, 1993), as well as the environmental signature recorded in coral density bands (Lough and Barnes, 1990, 1997), evidence of sediment and nutrient exposure (McCulloch et al., 2003; Wyndham et al., 2004; Sammarco et al., 1999), and a host of new analytical methods and approaches (Gagan et al., 1998; Sinclair et al., 1998; Barnes et al., 2003). In addition, palaeoclimate and palaeoenvironmental research based on GBR corals (typically massive *Porites* spp.) has advanced our knowledge on the most pressing threats to the GBR and coral reef ecosystems more broadly (McCulloch et al., 2003; De'ath et al., 2009; Lough et al., 2015; Wei et al., 2009; Koop et al., 2001), tropical climate processes (Hendy et al., 2002; Lough, 2007; Druffel and Griffin, 1993), reef responses to climate and sea-level change (Webster et al., 2018; Sanborn et al., 2020; Yokoyama et al., 2011; Leonard et al., 2020), and coral bleaching (Suzuki et al., 2003; D'Olivo and McCulloch, 2017; De'ath et al., 2012).

Despite the long history of coral palaeoclimate and environmental research on the GBR, the GBR coral research data like other research fields are being lost to time (Vines et al., 2014). While there is a recent push to ensure that coral geochemical records are publicly available upon publication (Kaufman and PAGES 2k special-issue editorial team, 2018; Khider et al., 2019; Dassié et al., 2017), many GBR coral core records are not yet publicly archived; thus, we risk losing these valuable datasets. The need to publicly archive GBR coral geochemical data is even more pressing as corals are under threat from human-induced stresses (Hughes et al., 2017; Maynard et al., 2015; Guan et al., 2020; Ortiz et al., 2018). Long-term monitoring of the GBR indicates that reef-wide hard coral cover was down to 18 % in 2017 (Australian Institute of Marine Science, 2017). Since then, hard coral cover has increased, but recovery has primarily been driven by fast-growing *Acropora* species (Australian Institute of Marine Science, 2017, 2022), which are less suitable for producing continuous multi-century records. The future of GBR corals and therefore the valuable geochemical records they contain faces an uncertain future, which makes existing GBR records a precious and potentially finite resource.

This study presents a comprehensive database of GBR coral geochemical and luminescence records, as well as associated variables such as growth characteristics (where available), compiling both published records (201) and records published here for the first time (7 records). The GBR Coral Skeletal Records Database (GBRCD) transfers data into a standardised machine-readable format (structured using a consistent logic readable by and between machines) and makes the records available to researchers in a searchable database. The database consists of two main parts: (1) individual comma-separated values (CSV) files consisting of a single coral's geochemical and luminescence measurements with the associated age estimate and (2) a metadata file for the entire suite of corals, which includes details of location, genus or species, analytical techniques, publications, cross-references, and other details. Alternatively, the GBRCD is available as Linked Paleo Data (LiPD) files with serialisations in Python, MATLAB, and R, which include the same fields standardised to the LiPD format and terminology. Basic analysis of the scope of the database is presented, as is a discussion of database caveats and future use. The GBRCD addresses the potential loss of existing GBR coral data and provides the ability to easily explore what records exist. The GBRCD is a valuable resource for exploratory analysis to understand the GBR (and the wider Pacific) environment (e.g. Henley et al., 2024) and preserves the records for future use.

1.1 GBR setting

The GBR is made up of more than 3000 reefs that span 14° of latitude, and the World Heritage area comprises an area of 348 000 km^2. The width of the GBR across the continental shelf changes with latitude, ranging from 50 to 250 km wide (Steinberg, 2007; Hopley et al., 2007). Thus, coral reefs in the GBR can be classified based on their proximity to the Queensland coast and sea floor depth as either inner-shelf, mid-shelf, or outer-shelf reefs and; depending on their clas-

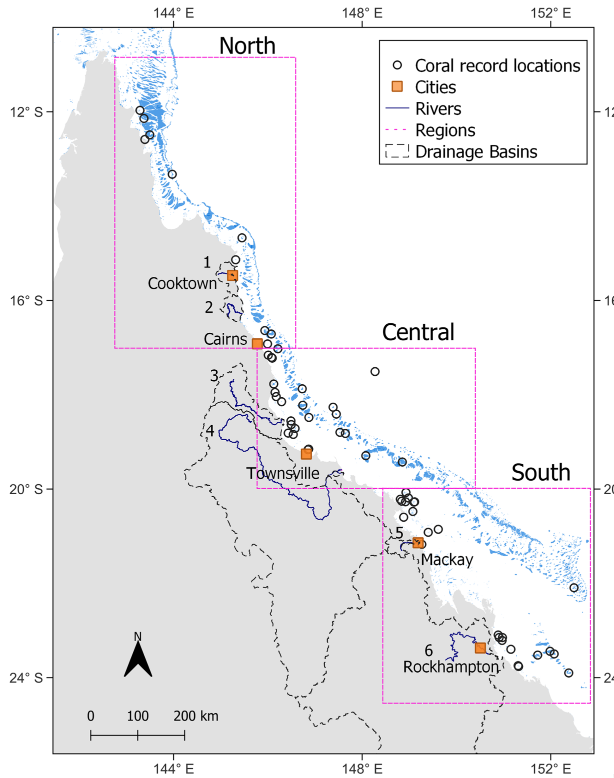

Figure 1. Map of locations with coral records in the Great Barrier Reef Coral Skeletal Records Database. Record locations are indicated by circles; select cities are indicated by orange squares; select rivers are indicated by dark blue lines; reefs are in light blue; and the nominal regions of the north, central, and south GBR are indicated by the dashed pink lines. Numbers identify rivers – 1: Endeavour River, 2: Daintree River, 3: Herbert River, 4: Burdekin River, 5: Pioneer River, and 6: Fitzroy River. The drainage basin boundary associated with the included rivers is indicated by the dashed black lines. GIS layers © State of Queensland (Department of Resources) 2023. This material is licensed under a Creative Commons – Attribution 4.0 International licence (https://creativecommons.org/licenses/by/4.0/, last access: TS1). See Appendix G for a full list of included GIS layers.

sification, these reefs will experience various gradients of terrigenous or open ocean influences. There is a seasonal atmospheric circulation that is characterised by an annual summer monsoon (December to March), which brings rainfall and increased river discharge to neighbouring GBR marine waters.

Average sea surface temperature (SST) varies latitudinally, with a 1.65 °C difference between the northern region (11–17° S) and the southern region (20–24° S) (Fig. 1) for the 1981–2010 period (HadISST; Rayner et al., 2003). The timing of the annual minimum and maximum also varies slightly; mean maximum SST in the 1981–2010 period (HadISST1.1) most frequently occurs in February in the central and southern GBR and in January in the northern GBR, while minimum SSTs most frequently occur in August in the northern and southern GBR and in July in the central GBR.

The modern GBR coral reef ecosystem initiated ∼ 8000–9000 years ago (ka) following the Holocene marine transgression (Davies and Hopley, 1983; Davies et al., 1985; Dechnik et al., 2015; Hopley et al., 2007), although the timing of individual coral reef initiation and vertical accretion rates varied considerably (range of 1–16 m every 1000 years) (Dechnik et al., 2017; Sanborn et al., 2020; Davies and Hopley, 1983; Hopley et al., 2007; Leonard et al., 2020; Ryan et al., 2018). Decreases in reef growth rate occur where the reef surface is within ∼ 2–3 m of sea level due to reduced growth and/or erosional loss (Davies and Hopley, 1983). Evidence from reef drilling suggests that there was little latitudinal variation in reef growth rate throughout the GBR, although the depth to the Pleistocene reef foundations in the northern and southern GBR regions is shallower than the central region (e.g. Davies et al., 1985; Hopley et al., 2007). Additionally, there are reef-flat growth hiatuses in both the northern and southern GBR, but not in the central GBR, due to a relative fall in sea level of ∼ 0.5 m in the other regions that was not evident in the central GBR due to subsidence in the central region (Halifax Basin) from hydro-isostatic adjustment (Dechnik et al., 2017).

1.2 Palaeoclimate and palaeoenvironment reconstructed from GBR coral skeletons

Research on the GBR has a long history of discovery and scientific development, with ventures as far back as the 1928–1929 GBR expedition lauded as having promoted the development of empirical and analytical approaches important to the foundation of modern coral reef science (Spencer et al., 2021). Coral skeletons provide in situ records of the reef environment as they incorporate trace elements, a variety of element isotopes, and organic materials in proportion to climate and environmental variations in the marine environment. These palaeoclimate and palaeoenvironment proxies are a long-established method to assess the reef environment in the past and present, and they provide a means to quantify relative changes over space and time. Proxy records from coral skeletons offer the ability to extract high-resolution (weekly–monthly) information to assess a range of climate and environmental variables, most commonly SST and rainfall, and at a variety of scales, e.g. near-weekly records that extend from the present day back several centuries prior to the instrumental record (e.g. Lewis et al., 2012; D'Olivo and McCulloch, 2022).

Beginning in the late 1960s, studies using GBR corals provided empirical evidence of a relationship between skeletal oxygen isotopes, luminescence, trace elements, radiocarbon, density, and the coral's marine environment (Weber and Woodhead, 1969, 1970, 1972; Isdale, 1984; Druffel and Griffin, 1993; Lough and Barnes, 1990; McCulloch et al., 2003), and these studies were at the forefront of the development of new technologies and methods to measure these coral properties (Isdale et al., 1998; Gagan et al., 1998; Sinclair et al., 1998; Barnes et al., 2003; D'Olivo et al., 2018).

After the description of the utility of Sr/Ca as an SST proxy by Beck et al. (1992), coral skeleton proxy research in the GBR focused on development and calibration of proxy–SST relationships in the 1990s. GBR coral records from this period are generally short (< 10 years) and were analysed using a variety of spectrometry methods (Alibert and McCulloch, 1997; Druffel and Griffin, 1993, 1999; McCulloch et al., 1994; Gagan et al., 1998; Sinclair et al., 1998). Research in the 1990s also included the first application of paired Sr/Ca and δ^{18}O proxies to reconstruct the GBR palaeoenvironment (McCulloch et al., 1994; Gagan et al., 1998) and the further exploration of coral luminescence as a proxy for river discharge (Isdale et al., 1998). These approaches were applied to extend our knowledge of GBR SST, riverine input, and oceanographic variability prior to the 1800s (Lough, 2007, 2011b; Hendy et al., 2002, 2003a; Calvo et al., 2007) and during the Holocene (Gagan et al., 1998; Leonard et al., 2016; Sadler et al., 2016b; Lough et al., 2014; Roche et al., 2014) .

Since the 2000s, partially facilitated by the development of the Australian Institute of Marine Science luminometer and The Australian National University laser ablation methods, research on coral proxies in the GBR has focused on proxies for terrigenous inputs. These include indicators of terrestrial runoff and sediment exposure (e.g. Ba/Ca and rare earth elements (REEs) (Jupiter et al., 2008; Jupiter, 2008; Saha et al., 2021; McCulloch et al., 2003; Lewis et al., 2012; Leonard et al., 2019)), land-use changes (e.g. δ^{15}N and Mn (Lewis et al., 2007, 2012; Erler et al., 2016, 2020; Marion et al., 2021)), and river flow patterns (e.g. Ba/Ca and luminescence (Lough et al., 2002; Lough, 2007; Lough et al., 2014; D'Olivo and McCulloch, 2022)). Additionally, there is continuing research that aims to explore new proxies (e.g. V/Ca (Saha et al., 2019a) and δ^{98}Mo (Wang et al., 2019)), as well as to develop proxies relevant to global issues such as ocean acidification (e.g. δ^{11}B (Pelejero et al., 2005; Wei et al., 2009; D'Olivo et al., 2015; McCulloch et al., 2017)).

2 Overview of the GBR Coral Skeletal Records Database

2.1 Selection criteria for inclusion in GBRCD

The GBRCD was not assembled around a specific research goal, unlike other coral palaeoclimate databases such as the CoralHydro2k database (Walter et al., 2023), which was designed to support "the project's goal of reconstructing tropical hydroclimatic variability at seasonal and longer timescales". The GBRCD compiles and makes available coral geochemical and luminescence data from the GBR in a user-friendly format to facilitate their use in research. The GBRCD is similar to the Coral Trait Database (Madin et al., 2016) but focuses on the GBR and coral proxy measurements (i.e. geochemical and luminescence measurements). Therefore, only three broad selection criteria are considered for including a record in the GBRCD:

- *Location.* The GBRCD compiles coral records from the GBR and, due to its regional context and latitudinal relevance, Flinders Reef.
- *Length.* The records are continuous (multi-year) measurements from coral skeletons.
- *Age model.* Each record includes a relevant chronology (i.e. an estimate of age as the independent variable) or has a chronology that could be recreated relatively easily based on available data.

All available geochemical or luminescence data were included in the GBRCD if they met these three criteria. No screening was applied on the quality of the data, and no records were excluded based on analytical uncertainties, diagenesis screening, resolution (e.g. weekly, monthly, annual), significance of the correlation between proxy and target parameter, or record length. It is at the discretion of researchers using data from the GBRCD to determine the suitability for their aims.

Where available, additional variables, such as coral growth data (density, extension, etc.), are included alongside the geochemical and luminescence data for records in the GBRCD where the additional variable data are at the same resolution as the geochemical or luminescence measurements.

2.2 Data sources

The majority of GBR coral records are from peer-reviewed published studies (see Appendix Table A1). In many cases, the published records were publicly archived in repositories such as the NOAA National Centers for Environmental Information World Data Service for Paleoclimatology (NOAA/WDS Paleoclimatology) and World Data Center PANGAEA. The GBRCD includes digital object identifier (DOI) information linking back to these original sources and publications. In some cases, published studies included additional records that were not archived in public repositories. Instead, these data were obtained from the publication's supplemental material or by reaching out to the corresponding authors. As part of the GBRCD compilation process, 114 previously unarchived records, as well as the 7 previously unpublished records, were submitted to NOAA/WDS Paleoclimatology for archiving. These files are in the standard NOAA/WDS Paleoclimatology (tab-delimited) file format.

Seven records have not been published previously and are published in the GBRCD for the first time (Table 1 and Appendix A and C). These records are accompanied by their associated metadata record and appropriate background information (see Appendix A, C, D). If further information about the record is required, users are encouraged to reach

Table 1. Records first published in the GBRCD.

Record ID	Variables	Reef location
AR24DIP01	Ba/Ca; Mg/Ca; Sr/Ca; U/Ca; Y/Ca	Dip Reef
AR24OTI01	Sr/Ca	One Tree Island
AR24OTI02	Ba/Ca; B/Ca; Ca/Ca; Mg/Ca; Sr/Ca; U/Ca	One Tree Island
AR24OTI03	Ba/Ca; B/Ca; Ca/Ca; Mg/Ca; Sr/Ca; U/Ca	One Tree Island
AR24OTI04	Ba/Ca; B/Ca; Ca/Ca; Mg/Ca; Sr/Ca; U/Ca	One Tree Island
AR24OTI05	Ba/Ca; B/Ca; Ca/Ca; Mg/Ca; Sr/Ca; U/Ca	One Tree Island
AR24SLY01	δ^{13}C; Δ^{14}C; δ^{18}O	Stanley Reef

out to the first author/contact listed in the GBRCD publication metadata.

Records included in the database are multi-year measurements of coral geochemistry and luminescence signals. In total, there are 78 variables available to investigate the GBR environment or to determine new proxy–environment relationships (Table 2). The records include commonly measured isotopes and trace elements (TEs) such as δ^{18}O, Ba/Ca, Sr/Ca, and U/Ca, as well as less explored isotopes (such as δ^{11}B and δ^{15}N) and emerging TE proxies such as Li/Mg and rare earth elements (REEs). Luminescence records are included in the database as coral luminescence is a proven hydrological proxy in the GBR (Lough, 2011 TS2; Lough et al., 2014).

Care is advised for the use of all records in the GBRCD as the relevance of the measured variables may vary by location, or the sampling resolution of the records may not be suitable. Therefore, further processing needs to be considered before integrating or comparing the records.

2.3 Database structure

The database is provided in a split form and includes a table of metadata describing each record, as well as individual CSV files that include the coral variables such as age, distance down core, measured trace elements, and so on. It is also provided as LiPD serialisations with the metadata fields structured as per the LiPD format (see Table B1). The database is available in both formats to facilitate ease of use. The CSV files are easily accessible and do not need programming languages (e.g. R or Python) to explore the datasets, whereas the LiPD files require programming languages to fully access that data and are designed as structured data to enable interoperability and quick analysis of palaeoclimate data (McKay and Emile-Geay, 2016).

The metadata supplied alongside the coral record data provide a thorough background on each record, with assumptions and limitations made clear for researchers. While every best attempt has been made to provide information for all metadata fields that are relevant, there are some fields where the information was not available (i.e. flagged with "NA"). Metadata fields allow for filtering by site, coral genus or species, analysis method, proxy type, etc.

Individual CSV and LiPD files are provided for each coral record. In general, an individual record is defined as being from a single coral, whether a coral head was drilled directly or the coral was retrieved from a core that was drilled into a coral reef matrix (coral reef matrices can intersect individual coral heads as well as the reef framework in which they are preserved).

In some instances, multiple geochemical and/or luminescence records have been measured from the same coral head. In this situation, the multiple records have their own separate entries as they are usually either part of an included composite record, measured using different techniques, or have sufficient differences in the metadata or dataset to provide a good reason not to attempt to join the datasets. However, they are identified and cross-referenced in the database as being from the same coral or core.

2.4 Data processing

Published data, as was available or supplied, have been archived in the database format described here. Potentially abnormal data (e.g. values < 0 for Mg/Ca (after correcting against a method and/or lab standard)) were not removed from the datasets as they may be indicative of climate or environmental events, and it is up to the user to determine appropriate screening procedures when using the database.

A basic quality check was conducted on records published for the first time in the GBRCD (see Appendix C and F). This consisted of creating or adjusting the coral age model based on available information and checking for diagenetic alteration where there was a physical sample available.

Coral records that were archived or supplied with the ages in standard date format (e.g. DD/MM/YYYY) had all ages converted to decimal date in the Common Era (CE) or Before Common Era (BCE) format. This means that there is no year zero, and negative (BCE) numbers start at "−1". Since there are rounding issues with decimal dates assigned to the first day of the month (at midnight), 12 h was added to each date to ensure the age remained assigned to the correct month of the year.

For archiving purposes, 16 records were assigned a new age model. This was primarily because the coral data were not available with an age model or did not have one appropri-

Table 2. Example of the process of giving core records a unique identifier.

GBRCD ID	Core ID from publication	Publication reference	Location	Variables	Resolution	Split	Comments
SA16HER01a	AR HL 3	Sadler et al. (2016a)	Heron Reef	Sr/Ca	Biannual	Core 1	Suffix identifier for record as different coral(s) with publication(s) in the same year at the same reef location
SA16HER01b	P HS 1	Sadler et al. (2016b)	Heron Reef	Sr/Ca	Bimonthly	Core 1	Suffix identifier for record as different coral(s) with publication(s) in the same year at the same reef location
WE09ARL01_1	AREO 4	Wei et al. (2009)	Arlington Reef	Ba/Ca; δ^{11}B; δ^{13}C; δ^{18}O; Mg/Ca; Sr/Ca; δ^{11}B pH	Annual	Core 1, split 1	Record split due to difference in measurement resolution
WE09ARL01_2	AREO 4	Wei et al. (2009)	Arlington Reef	Ba/Ca; δ^{11}B; δ^{13}C; δ^{18}O; Mg/Ca; Sr/Ca; δ^{11}B pH	> Annual	Core 1, split 2	Record split due to difference in measurement resolution

ate for archiving (e.g. date not assigned to each data point). A note is included in the relevant field about the chronology for records where the chronology was (re)created for archiving in the GBRCD, and further details are provided in Appendix C. Nine fossil records were supplied or previously archived with chronologies relative to the record itself (i.e. 0 = first or youngest year of record). The available dating information was used to transform these chronologies to Common Era ages.

Before Common Era fossil coral data are included in the GBRCD. Absolute age estimates for these corals are based on uranium–thorium (U-Th, or U-series) dating and radiocarbon (^{14}C) measurements, with basic information about the dating supplied in the GBRCD metadata. Five coral records dated by radiocarbon measurements were recalibrated using CALIB rev. 8 (Stuiver and Reimer, 1993) and the Marine20 radiocarbon age calibration curve (Heaton et al., 2020) to standardise the age estimates, and details (including the local delta-R reservoir correction) are available in the "dating_notes" field. Users of the GBRCD should determine if the radiocarbon ages of the fossil records should be revised based on future updates to the calibration curves and/or reservoir ages. For records where U-Th dating information is reported for the first time in this study, information is provided in the GBRCD metadata, and complete relevant U-Th dating information (Dutton et al., 2017) is included in Appendix Table D1.

Relevant metadata were obtained from source publications and, where necessary, subsequent or cited publications and data archives. Coral IDs were also matched across publications and within the GBRCD, using literature searches and the AIMS reef core database CE1.

2.5 Database records and identification

Records are identified here as datasets from a single coral that may include one or more measured variables unified with a single age model. Similar to the Iso2k database protocols (Konecky et al., 2020), each record in the database was given a nine-digit alphanumeric ID. The dataset ID was created from the first two letters of the first author's last name, the last two numbers of the year of publication, the first three letters of the location (or in cases where a commonly accepted shortening or three-letter acronym for the location was used), and two numbers that represent the core number. If data were not previously published, publication year was substituted with the year of this compilation. For reef locations in the GBR that are currently represented by a number rather than a name and for records that are the composite of multiple locations, "GBR" has been used as the three-letter reef location for core naming purposes.

However, the Iso2k nine-digit alphanumeric identifier was insufficient to separate records where researchers have published multiple papers from the same GBR location within the same year. To separate these records, a 10th digit was added to the ID, adding an alphabetical end code of "a", "b", and so on following the order of publication (Table 2), similar to many journal standards for uniquely identifying references. Additionally, where the core record has been split due to notable differences in the record (e.g. due to data resolution or age model), a split identifier of "_1" or "_2" has been appended to the end of the identifier (Table 2).

2.6 Database variables, units, and standards

Records are all standardly formatted as CSV and LiPD files, with each record containing an age field and variable field(s)

Table 3. The database record format describes the format of the CSV files of each record.

Field name	Variable	Type	Description
Age	Age	numeric	Time data for the record. All time data are expressed as a decimal date. Annual or greater resolution default to [year] (equivalent of [year].0) unless original publication specified otherwise. Units: CE.
[variable]	Data	numeric	A $N \times 1$ vector of proxy data. Data type is specified in the list of proxy and additional variables listed in Table 4. Units are specified in Table 4.

as per Table 3. Each GBRCD record includes between 1 and 33 variables.

The database collates 78 variables obtained from coral records: 72 measured and 6 calculated variables (Table 4).

Units reported in the database were standardised to enable interoperability among records. All trace-element / calcium (TE/Ca) ratios were included (as mmol mol^{-1}TS5), and where relevant, the calibrations (proxy–SST) for the ratios included in the record metadata are in the same units. Isotopes were archived as permille (‰), and, where relevant, the calibrations for the ratios are in the same units. The majority of non-ratio elements were archived as parts per million. The exceptions to this were the rare earth elements (REEs) (lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb), and lutetium (Lu)), yttrium (Y), and zirconium (Zr), which were archived as parts per billion (i.e. 10^9CE2).

The list of included dataset field names for each record is provided in the metadata file (i.e. "meths_primaryVariableList" or "meths_additionalVariableList"; Table 4).

All records include an "Age" field that is the age of each sample as determined by the coral age model. For records that are at greater than annual resolution, the age supplied is representative of the grouping of years included in each data point. For example, the Druffel and Griffin (1999) biennial data list the middle year of the sampled coral (i.e. October 1889 to October 1891) and has the age of 1890.8, while Hendy et al. (2002) quinquennial resolution data list the middle year of the sampled coral (i.e. 1981 to 1985 has the age of 1983). For sub-annual resolution records, the tie point within each month varies depending on the researchers' choice in the original publications. It is up to researchers to inspect the data to understand the "Age" field for each record they intend to use.

2.7 Coral database metadata

The GBRCD contains 104 metadata fields in the CSV version (reduced or combined into 76 fields in the LiPD version; Table B1) that enable identification and investigation of the coral records. Information for the metadata fields have been sourced from publications, supplementary materials, data archive information, and personal communications with researchers.

Nine fields are notes or free-form text fields that provide useful information for future investigations and understanding the record that cannot be succinctly reduced to controlled vocabulary and/or a numerical value.

The metadata included in the GBR coral record database were divided into six categories (identifier, geographic, publication, analysis, calibration, and dating), based on best practice standards suggested by the Marine Annually Resolved Proxy Archives (MARPA) (Dassié et al., 2017), Paleoclimate Community reporTing Standard (PaCTS) 1.0 (Khider et al., 2019), and Paleoenvironmental Standard Terms (PaST) Thesaurus (Morrill et al., 2021) and based on standards implemented in other palaeo-archive databases such as Iso2k and CoralHydro2k (Walter et al., 2023; Konecky et al., 2020)CE3.

2.7.1 Identifier metadata

Identifier fields were used to distinguish and characterise each coral record and identify potential crossover (or duplication) between records in the database and other research (Table 5). Identifier fields include core names (as specified in the original publication(s)), International Generic Sample Number (IGSN), core collection time, coral archive species, and the record period (maximum (max) and minimum (min) year). The metadata for the record period aim to maximise users' abilities to find relevant records that may only include measurements for part of a year; for example, the max year for records ending in March 2000 or November 2000 would be 2000 for both.

The database includes 67 duplicate core names, which generally indicate different types of analyses on the same coral head, reflecting the development and use of new analysis techniques. For example, TE/Ca may be measured from the same core using different methods (e.g. inductively coupled plasma massCE4 spectrometer (ICP-AES) or laser ablation inductively coupled plasma mass spectrom-

Table 4. Data variables. Describes variables included in the database, units, type, and brief description. The list of variables is alphabetical.

Field name	Variable	Type	Units	Unit abbreviation	Description
Arag	Ω_{arag}	calculated	dimensionless		Aragonite saturation state determined from calculated δ^{11}B pH.
Ba	Ba	measured	parts per million	ppm	Barium
Ba138Ca	Ba/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Barium / calcium A secondary Ba/Ca measurement for laser ablation. This is a measure of the total Ba/Ca using the count intensities of the Ba^{138} isotope.
BaCa	Ba/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Barium / calcium For laser ablation, this is a measure of the total Ba/Ca using the count intensities of the Ba^{137} isotope.
BCa	B/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Boron / calcium
BMg	B/Mg	measured	millimole mole^{-1}	mmol mol^{-1}	Boron / magnesium
Ca	Ca	measured	parts per million	ppm	Calcium
CaCa	Ca/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	A measure of the total Ca/Ca ratio using the count intensities of the Calcium^{48}/calcium^{43} isotopes.
Calcn	Calcification rate	calculated	grams centimetre^{-1} year^{-1}	g cm^{-1} yr^{-1}	Annual coral calcification rate.
Cd	Cd	measured	parts per million	ppm	Cadmium
CdCa	Cd/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Cadmium / calcium
Ce	Ce	measured	parts per million	ppm	Cerium (REE)
CeCa	Ce/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Cerium / calcium
CeCe_anom	Ce/Ce*	calculated	dimensionless[a]		Cerium anomaly calculated[b] as $\left(\frac{Ce}{Ce}\right) = \left(\frac{Ce_{sn}}{Pr_{sn} x \left(\frac{Pr}{Nd}\right)_{sn}}\right)$ (1)
d11B	δ^{11}B	measured	permille	permil (‰)	^{11}B/^{10}B
d11B_pH	δ^{11}B pH	calculated	dimensionless		pH calculated from δ^{11}B.
d11B_pHcf_pres	δ^{11}B pH$_{cf}$	calculated	dimensionless		pH of calcifying fluid calculated from δ^{11}B. Values are pressure corrected.
d13C	δ^{13}C	measured	permille	permil (‰)	^{13}C/^{12}C

Table 4. Continued.

Field name	Variable	Type	Units	Unit abbreviation	Description
D14C	$\Delta^{14}C$	measured	permille	permil (‰)	$\delta^{14}C$ ($^{14}C/^{12}C$) deviation from a standard and corrected for $\delta^{13}C$.
d15N	CS-$\delta^{15}N$	measured	permille	permil (‰)	$^{15}N/^{14}N$ $\delta^{15}N$ of skeleton bound organic matter.
d18O	$\delta^{18}O$	measured	permille	permil (‰)	$^{18}O/^{16}O$
d18Osw	$\delta^{18}O_{seawater}$	calculated	permille	permil (‰)	$\delta^{18}O$ of seawater calculated from paired $\delta^{18}O$ and Sr/Ca.
d66Zn	$\delta^{66}Zn$	measured	permille	permil (‰)	$^{66}Zn/^{64}Zn$
d98Mo	$\delta^{98}Mo$	measured	permille	permil (‰)	$^{98}Mo/^{95}Mo$
Density	Density	measured	grams centimetre^{-1}	g cm^{-1}	Annual average coral density.
Distance	Distance	measured	millimetres	mm	Distance measured from outer edge of coral or core.
Dy	Dy	measured	parts per billion	ppb	Dysprosium (REE)
Er	Er	measured	parts per billion	ppb	Erbium (REE)
Eu	Eu	measured	parts per billion	ppb	Europium (REE)
EuCa	Eu/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Europium / calcium
Extn	Extension rate	measured	millimetres year^{-1}	mm yr^{-1}	Annual linear extension rate of coral.
Fe	Fe	measured	parts per million	ppm	Iron
FeCa	Fe/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Iron / calcium
Gd	Gd	measured	parts per billion	ppb	Gadolinium (REE)
GdCa	Gd/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Gadolinium / calcium
Ho	Ho	measured	parts per billion	ppb	Holmium (REE)
La	La	measured	parts per billion	ppb	Lanthanum (REE)
LaCa	La/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Lanthanum / calcium
LiCa	Li/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Lithium / calcium
LiMg	Li/Mg	measured	millimole mole^{-1}	mmol mol^{-1}	Lithium / magnesium
Lu	Lu	measured	parts per billion	ppb	Lutetium (REE)
LuCa	Lu/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Lutetium / calcium
Lumin	Luminescence	measured	dimensionless		Coral luminescence as measured by luminometer.
LuminGB	Luminescence G/B	measured	dimensionless		Luminescence calculated from spectral green/blue ratio measured by spectral luminescence scanning.

Table 4. Continued.

Field name	Variable	Type	Units	Unit abbreviation	Description
LuminInd	Luminescence visual indices	measured	dimensionless		Annual coral luminescence indices as determined by visual assessment of annual luminescence lines.
LuminRange	Luminescence range	measured	dimensionless		Annual luminescence range as measured by luminometer; determined by difference between annual (summer) maximum luminescence and preceding annual (winter) minimum luminescence.
LuminSF	Luminescence sum	measured	dimensionless		Standardised annual fluorescence/luminescence calculated by interpolating and summing 12 values between annual minimum (winter) luminescence values.
MgCa	Mg/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Magnesium / calcium
Mn	Mn	measured	parts per million	ppm	Manganese
MnCa	Mn/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Manganese / calcium
Mo	Mo	measured	parts per million	ppm	Molybdenum
Nd	Nd	measured	parts per billion	ppb	Neodymium (REE)
NdYb	Nd/Yb	measured	dimensionless[a]		Neodymium / ytterbium (REE)
P	P	measured	parts per million	ppm	Phosphorus
PbCa	Pb/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Lead / calcium
PCa	P/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Phosphorus / calcium
Pr	Pr	measured	parts per billion	ppb	Praseodymium (REE)
PrCa	Pr/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Praseodymium / calcium
REEsCa	ΣREE/Ca	measured	dimensionless[a]		Sum of REEs / calcium
Sm	Sm	measured	parts per billion	ppb	Samarium (REE)
SmCa	Sm/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Samarium / calcium
SrCa	Sr/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Strontium / calcium
Tb	Tb	measured	parts per billion	ppb	Terbium (REE)
Th	Th	measured	parts per million	ppb	^{232}Thorium
Ti	Ti	measured	parts per million	ppm	Titanium
Tm	Tm	measured	parts per billion	ppb	Thulium (REE)

Table 4. Continued.

Field name	Variable	Type	Units	Unit abbreviation	Description
UB	U/B	measured	millimole mole^{-1}	mmol mol^{-1}	Uranium / boron Calculated from U/Ca and B/Ca.
UCa	U/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Uranium / calcium
USr	U/Sr	measured	millimole mole^{-1}	mmol mol^{-1}	Uranium / strontium Calculated from U/Ca and Sr/Ca.
VCa	V/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Vanadium / calcium
Y	Y	measured	parts per billion	ppb	Yttrium (REY)
Yb	Yb	measured	parts per billion	ppb	Ytterbium (REE)
YbCa	Yb/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Ytterbium / calcium
YCa	Y/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Yttrium / calcium
YHo	Y/Ho	measured	parts per billion	ppb	Yttrium / holmium as mass ratio.
Zn	Zn	measured	parts per million	ppm	Zinc
ZnCa	Zn/Ca	measured	millimole mole^{-1}	mmol mol^{-1}	Zinc / calcium
Zr	Zr	measured	parts per billion	ppb	Zirconium

[a] data considered dimensionless (N. TS3 Saha, personal communication TS4)
[b] Ce/Ce* formula (Eq. 1) from Saha et al. (2019b) per Lawrence et al. (2006)

eter (LA-ICP-MS)) or may be measurements of different variables (e.g. TE/Ca and luminescence). However, it also demonstrates the concentration of analyses on particular coral heads. For example, 5 of the 21 records from Magnetic Island in the central GBR are analyses from MAG01D and include an approximately weekly resolution multi-trace-element LA-ICP-MS record, approximately annual resolution stable isotope record, biennial resolution multi-trace-element inductively coupled plasma mass spectrometer (ICP-MS) record, quinquennial resolution stable isotope and trace-element record, and annual resolution luminescence record.

A notes field ("cdata_coralNotes"; Table 5) is also included for additional information on the coral, including issues and observations for consideration if using the record.

2.7.2 Geographic metadata

Geographic fields (Table 7) provide further core identification information and give the physical location of the coral archive: geographic coordinates, site name, and depth of the colony (termed "elevation" below).

Coral records that did not have listed GPS coordinates for the data were assigned GPS coordinates using the "Reefs and shoals – Queensland" dataset (EPSG:4283 – GDA94 coordinate reference system) from the State of Queensland (Department of Natural Resources, Mines and Energy) 2021, available under a Creative Commons – Attribution 4.0 International (https://creativecommons.org/licenses/by/4.0/, last access: TS6) licence. GPS coordinates were approximately matched to the supplied location if a sufficiently detailed map was included in the publication or the coordinates approximating the reef centre were used. Where coordinates were supplied for the GBRCD or the coordinates have been changed or updated from what was published in the original publication, this is noted in the "geo_notes" field.

Elevation information is supplied for coral records in the "geo_elevation" field. This value includes uncertainties inherent in the published data as elevation may describe depth below sea level to top or bottom of the coral, and this is not always explicitly described. Likewise, the choice of height datum used to describe sea level is also not always explicitly stated. Fossil coral records from drill core matrices have the depth down core range (if known), as well as an estimated depth within that range, noted in the "geo_notes" field. As there is uncertainty around the estimated depth down core, as well as uncertainty due to past changes in GBR sea level compared to present-day sea level (Lewis et al., 2013; Leonard et al., 2020; Hopley et al., 2007), it is left to the user to convert depth down core to an elevation relative to present-day sea level for fossil corals.

Table 5. Identifier metadata for the CSV version of the GBRCD for each coral record including database ID, publication core name, species, and time span.

Field name	Variable	Type	Description
cdata_datasetID	Dataset ID	text	A specific identifier assigned to all records, with specifics for the publication and site.
cdata_coreName	Core name published	text	Core name as specified in text in publications. Allows for tracing of coral records through past and future publications.*
cdata_altCoreName	Core name alternate	text	Alternate core name to cdata_coreName if more than one was used in the publication or where a different name was specified in datasets or secondary sources.
cdata_IGSN	International Generic Sample Number	text	IGSN identifier for sample identification of the physical coral samples. At the time of publication this field is empty.
cdata_collectTime	Time collected	text	The year and month (if available) the coral core was collected from living coral. Format is [year CE-month]. Alternatively, if core was from non-living coral, it was described as "Fossil" in this field.
cdata_minYear	Min year	numeric	First/oldest year of record. Recorded as integer years CE. Coral age decimal values were rounded down to the calendar year integer. Negative values are years BCE.
cdata_maxYear	Max year	numeric	Last/youngest year of record. Recorded as integer years CE. Coral age decimal values were rounded down to the calendar year integer. Negative values are years BCE.
cdata_archiveSpecies	Coral species	text	Coral genus and species (if known). Records where species name was unknown or not given were written as "[Genus] sp."* Note that species level identification of coral species (particularly *Porites* spp.) is open to disagreement and thus carries a level of uncertainty.
cdata_isDatabaseDuplicate	Duplicate coral core name flag	logic	Indicates whether coral core name appears more than once in GBRCD. Flags if coral records were split, and/or where the core name (cdata_coreName and cdata_altCoreName) was identical between publications.
cdata_dataCoverageGroup	Record coverage	numeric	The group the record was sorted into based on the length of the record. Groups range from 1 to 3 as described in Table 6.
cdata_coralNotes	Coral notes	text	Any notes on coral and additional information that does not fit into other fields, e.g. list of core names (if known) for composite records, record observations, and considerations.

* Descriptions based on Walter et al. (2023) CoralHydro2k database fields.

Table 6. Coral record coverage group and description relating to the field cdata_dataCoverageGroup.

Category	Description
1	Record length > 100 years
2	Record length 10–100 years
3	Record length < 10 years

2.7.3 Dating metadata

The GBRCD includes 18 BCE records that have chronologies determined in part by U-Th or radiocarbon dating. The dating metadata (Table 8) provide a brief overview of information available in the related record publications and include either the corrected U-Th age or uncalibrated ^{14}C age (± uncertainty) referenced to 1950 (yBP; years before present) as well as a summary of related information and/or assumptions.

The complete record (or all available) of essential information for reporting U-Th and radiocarbon dating can be found in the original publications. Dating information published for the first time in this study is supplied in Table D1.

2.7.4 Analysis metadata

Analysis fields provide information about or obtained during measurements of coral variables (Table 9). They include the list of proxies measured, information about sampling, analytical methods (acronyms given in Table 10), data resolution (as contained in the database record; Table 11), and analytical precision of measurements (annotations given in Table 12). They also include information such as whether the international coral reference JCp-1 (Okai et al., 2002; Hathorne et al., 2013) was measured and information published about screening for diagenetic alteration of the corals.

The coral data resolution is described as the minimum, maximum, mean, and median number of data points per year for each record. The measurements per year were calculated for complete calendar years based on all unique age dates for each record, as records were filtered assuming duplicate dates represent replicate samples. A nominal data resolution label was assigned to each record based on the calculated median resolution described in Table 11 and is a key field for filtering records in the database. The term nominal resolution suffix "_uneven" has been adopted from the CoralHydro2k database (Walter et al., 2023) to describe corals with a variable resolution (i.e. where the record's min, max, mean, and median resolutions are not the same). A notes field ("meths_methodNotes"; Table 9) is also included for information on the measurement method(s), including the sampling method and any additional methodology notes, as well as an identifier ("REEs measured") for every record where any of the REEs (as listed in Sect. 2.6 above) were included in the record.

2.7.5 Calibration metadata

Calibration metadata (Table 13) provide information about the creation of proxy–environment equations. Due to the ongoing focus and broader regional significance of proxy–SST calibrations, detailed information has been provided for proxy–SST calibrations (intercept, slope, slope uncertainty, and r^2) for "raw" (non-centred) data in associated fields for Sr/Ca, U/Ca, and δ^{18}O. Raw data are the data values after measurement processing, while centred (or anonymised) data are the raw data minus the data mean (which can be the mean of the whole record or part thereof). The calibration information for these SST proxies was included due to their historical use and the body of published research on their feasibility and/or application for reconstructing SSTs in the GBR. Where a centred calibration was preferred or the only one published, the calibration information is separate from the more frequently used non-centred equations. As there were additional proxy–environmental variable calibrations published for the database records, other calibration equations are provided in calibration notes where applicable. Availability of additional proxy–environment calibrations that are not provided in the database are also flagged.

2.7.6 Publication metadata

The GBRCD includes metadata for relevant publications relating to the coral records. The bibliographic information is supplied for up to three related publications with relevant bibliographic information separated into separate fields for ease of filtering and includes (where applicable) the DOI for the publication and the archived data (Table 14). Another field for an alternate data URL related to the coral record is also provided to enable referencing the original data location when it has been provided in article supplements or similar. If a record (or part thereof) was featured in multiple publications, the order of the bibliographic information was determined by the primary publication source of the data archived, and then the publications are generally in chronological order (oldest to newest) with preference for the most complete dataset or archive and method description for the data.

3 Database use and citation

The GBRCD is a comprehensive compilation of coral records from the GBR to date that spans −5885 to 2017 CE. The database enables the investigation of multiple environmental factors via various coral proxy systems for the GBR, northeastern Australia, and potentially the broader Indo-Pacific region. Researchers can select from a list of 78 measured or calculated variables to investigate the GBR environment or determine new proxy–environment relationships.

The GBRCD is freely available on the NOAA/WDS Paleoclimatology website at https://doi.org/10.25921/hqxk-8h74 (Arzey et al., 2024).

Table 7. Geographic metadata for the CSV version of the GBRCD for record(s) describing the physical location of each coral archive sampling location.

Field name	Variable	Type	Description
geo_latitude	Latitude	numeric	Latitude for the coral. All values are negative in the GBRCD due to GBR's location south of the Equator. See geo_notes for considerations.
geo_longitude	Longitude	numeric	Longitude for coral. All values are positive in the GBRCD due to the GBR's location within 180° east of the Prime Meridian. See geo_ notes for considerations.
geo_siteName	Site	text	Structured location names. Format follows site name: [name] Reef/Island, e.g. Abraham Reef or Havannah Island.
geo_siteName2	Site	text	Specific location name (if available) as supplied in publications, e.g. Geoffrey Bay, Heron Island Reef.
geo_elevation	Elevation	numeric	Elevation, if known, of corals in metres (m). Values are negative to indicate coral material was collected below present-day sea level or positive to indicate coral material was collected above present-day sea level. Where a range of values is reported the elevation is the average of the range.
geo_notes	Elevation notes	text	Any notes on coral geographic information. This includes reported specifics of coral elevation, such as the depth range listed or relationship to water height, information on fossil coral depths from drill core matrices (if available) and considerations.

Table 8. Dating metadata for the CSV version of the GBRCD. Basic information for dated samples.

Field name	Variable	Type	Description
dating_UThDate	U-Th Date	numeric	Uranium–thorium (U-Th) age corrected for initial thorium. If more than one age was measured, this field lists the youngest age, or the age used in the original record chronology. Units: years before present (yBP).
dating_UThDateUncertainty	U-Th Date Uncertainty	numeric	Uranium–thorium (U-Th) age (corrected) uncertainty. If more than one age was measured, this field lists the uncertainty for the youngest age, or the age used in the original record chronology. Units: yBP.
dating_14CDate	^{14}C Date	numeric	Uncalibrated radiocarbon (^{14}C) age. If more than one age was measured, this field lists the youngest age, or the age used in the original record chronology. Units: yBP.
dating_14CDateUncertainty	^{14}C Date Uncertainty	numeric	Uncalibrated radiocarbon (^{14}C) age uncertainty. If more than one age was measured, this field lists the uncertainty for the youngest age, or the age used in the original record chronology. Units: yBP.
dating_notes	Additional dating information	text	Any additional information relating to dating of corals such as the local delta-R reservoir correction used as well as assumptions used for database.

It is up to the user to determine applicable proxies for their investigation and filter records as needed. Best practice (Fig. 2) should begin with filtering by proxy or proxies of interest. Next the CSV dataset(s) should be joined with the metadata fields to enable further filtering of the database. It is then suggested to subsequently filter the data by other metadata of interest such as record coverage, resolution(s), and archive species. Users should read the field "cdata_coralNotes" for all records of interest as this includes

Table 9. Analysis metadata for the CSV version of the GBRCD. Description of fields relating to the measurement of coral data, including variables measured, analysis method and the age model used. Note "X" is used to represent a list of variables as stated in the description.

Field name	Variable	Type	Description
meths_primaryVariablesList	Proxy variables	text	List of proxy variables measured from coral archive. See Table 4 for complete list of variables.
meths_additionalVariablesList	Additional variables	text	List of variables that are not standard climate or environment proxy variables or are variables calculated from the measurement of proxy variables. See Table 4 for complete list of variables.
meths_XMethod	Method of X measurement	text	Method used for data measurement (X = TE, Isotope, Lumin), e.g. ICP-MS. Where multiple TE or Isotope methods are used across variables, this field lists the Sr/Ca or $\delta^{18}O$ method and other methods in meths_altMethodInfo. See Table 10 for the complete list.
meths_XMethodMachine	Machine for X data measurement	text	Description of machine used for data measurement, e.g. Finnigan MAT 251. (X = TE, Isotope, Lumin)
meths_altMethodInfo	Alternate proxy measurement information	text	List of proxy, method and machine used (if available) for data measurements not included in other method and machine information fields. Items are separated by ";".
meths_methodNotes	Sampling notes	text	Any notes on methods including a brief description of sampling method, and other record measurement notes that do not fit in other fields.
meths_hasResolutionNominal	Nominal resolution	text	Nominal temporal resolution of the coral record. Nominal choice is based on median frequency of coral data. See Table 11 for term definitions.
meths_resolutionMin	Minimum resolution	numeric	Minimum temporal resolution of the record, expressed as data points per year.
meths_resolutionMax	Maximum resolution	numeric	Maximum temporal resolution of the record, expressed as data points per year.
meths_resolutionMean	Mean resolution	numeric	Mean temporal resolution of the proxy record, expressed as data points per year.
meths_resolutionMedian	Median resolution	numeric	Median temporal resolution of the record, expressed as data points per year.
meths_isAnomaly	Anomaly data flag	logic	Indicates whether [variable] values are considered anomaly data. Anomaly definition and therefore calculation method may vary by publication.
meths_chronologyNotes	Notes on age model	text	Brief notes on method used to determine coral data age model. Field includes the target SST dataset and interpolation information if supplied. SST datasets include AIMS (Australian Institute of Marine Science), Extended Reconstructed SST (ERSST), Comprehensive Ocean-Atmosphere Data Set (COADS), Integrated global ocean station system (IGOSS), Hadley Centre Sea Ice and SST (HadISST), NOAA/Reyn-Smith Optimum Interpolation SST (OISST). Also includes methods for determining the age model for fossil corals where the age model incorporates the absolute age (Table 8).

Table 9. Continued.

Field name	Variable	Type	Description
meths_coralExtensionRate	Extension rate	numeric	Average coral extension rate in mm yr^{-1}. If a range was given in the publication, 'Extension rate' is the average of the range.*
meths_coralExtensionRateNotes	Extension rate notes	text	Coral extension rate given in the publication or determined from data. This field includes the units, uncertainty, or ranges in values which are not included in the previous field.
meths_tissueThickness	Tissue thickness	numeric	Average coral tissue thickness in millimetres (mm).
meths_jcpUsed	Flag for measurement of JCp-1	logic	Indicates whether the JCp-1 standard was measured.
meths_jcpSrCaValue	Measured value of JCp-1	numeric	Sr/Ca value measured for JCp-1 standard. Units: mmol mol^{-1}.
meths_XAnalyticalPrecision	Measured X analytical precision	numeric	Analytical error for measured proxy values based on a standard ($X =$ SrCa, UCa or d18O).
meths_XAnalyticalPrecisionUnits	X analytical precision units	text	Units of analytical error. ($X =$ SrCa, UCa or d18O). Units are relative standard deviation (RSD; %) for Sr/Ca and U/Ca, or permille (permil) for $\delta^{18}O$.
meths_altPrecisionList	Alternate proxies with analytical precision data	text	List of proxies with supplied analytical precision in addition to Sr/Ca, U/Ca or $\delta^{18}O$. See Table 12. Provided to enable comparing precision between studies and assess use of records for research. Items are separated by ";".
meths_altAnalyticalPrecision	Measured analytical precision	text	List of analytical error value(s) based on a standard for alternate proxies. Values are numerical and are separated by ";" with the order matching meths_altPrecisionList. See Table 12 for the list.
meths_altAnalyticalPrecisionUnits	X analytical precision units	text	List of units for alternate proxy analytical error(s). Units are separated by ";" with the order matching meths_altPrecisionList. See Table 12 for the list of units.
meths_archiveDiagenesisCheck	Diagenesis screening information	text	Information about diagenesis screening as reported in publications, including the method(s) used to check diagenesis. Where screening information was supplied it is reported as 'Yes; [method(s)]'. Methods used to check include X-ray diffraction (XRD), petrographic thin section (TS), scanning electron microscopy (SEM), and ultraviolet light assessment (UV).

* Descriptions based on Walter et al. (2023) CoralHydro2k database fields.

relevant information on caveats and assumptions (if any) that were noted for each record.

Sample code is available for R and Python.

As previously noted, care is advised for the use of all records in the GBRCD as relevance of the measured variables may vary by location or resolution and so forth. Records have been collated for the GBRCD and basic quality checks have been completed on the data to enable archiving for this study.

If researchers use the GBRCD, they should cite this study and the most recent version description of the GBRCD. It is also best practice to cite the original publications of the data (Table A1) alongside the GBRCD database. Citation information and reference links to the original publications and data archive are included in the metadata (i.e. Table 14).

Table 10. Description of abbreviations of methods used for the meths_XMethod field given in Table 9.

Method acronym	Method
AMS	Accelerator mass spectrometry
GC	Gas counting CE6
ICP-AES	Inductively coupled plasma atomic emission spectrometry
ICP-OES	Inductively coupled plasma optical emission spectrometry
ICP-MS	Inductively coupled plasma mass spectrometry
ID-TIMS	Isotope dilution thermal ionisation mass spectrometry
IRMS	Isotope ratio mass spectrometry
LA-ICP-MS	Laser ablation inductively coupled plasma mass spectrometry
LSA	Liquid scintillation analysis
MC-ICP-MS	Multicollector inductively coupled plasma mass spectrometry
MS	Mass spectrometry
PTIMS	Positive thermal ionisation mass spectrometry
Q-ICP-MS	Quadrupole inductively coupled plasma mass spectrometry
SSAMS	Single-stage accelerator mass spectrometry
TIMS	Thermal ionisation mass spectrometry

Table 11. Description of terms for nominal resolution.

Nominal resolution	Data points per year
weekly; weekly_uneven	>=52 TS7 data points per year; "_uneven" was added to records with variable resolutions that typically have over 52 data points per year.
fortnightly; fortnightly_uneven	26 data points per year; "_uneven" was added to records with variable resolutions that typically have 26–51 data points per year.
monthly; monthly_uneven	12 data points per year; "_uneven" was added to records with variable resolutions that typically have 12–25 data points per year.
bimonthly; bimonthly_uneven	6 data points per year; "_uneven" was added to records with variable resolutions that typically have 6–11 data points per year.*
quarterly; quarterly_uneven	4 data points per year; "_uneven" was added to records with variable resolutions that typically have 4–5 data points per year.*
biannual; biannual_uneven	2 data points per year; "_uneven" was added to records with variable resolutions that typically have 2–3 data points per year.*
annual; annual_uneven	1 data point per year; "_uneven" was added to records with variable resolutions that typically have 1 data point per year, and are missing years of data.
> annual	Less than 1 data point per year.*

* Descriptions based on Walter et al. (2023) CoralHydro2k database fields.

4 Characterising the database

4.1 Record coverage

The GBRCD compiles 208 individual records published since the early 1990s from 58 named reefs and islands (Fig. 1). There are 193 (92.8 %) records from *Porites* spp., 8 (3.8 %) from *Isopora* spp., 6 (2.9 %) from *Acropora* spp., and 1 (0.5 %) from a *Cyphastrea* sp. coral. The coral records include 78 variables, of which 72 are measured and 6 are calculated. The majority (116) of records are from the cen-

Table 12. List of isotopes, trace elements, and trace-element ratios, with analytical precision values supplied in meths_altPrecisionList. The list of variables is formatted as per meths_altPrecisionList. Units are as provided by the original publication(s) or as supplied.

Type	List	Units
Isotope	d11B, d13C, d14C, d15N	permille (permil)
Trace element	Ba, Mn, Th, Y	RSD (%)
Trace-element ratio	BaCa, Ba138Ca, BCa, BMg, LiMg, MgCa, MnCa, REEsCa, Sr88Ca*, YCa	RSD (%), mmol mol^{-1}

* Sr88Ca = Sr^{88}/Ca as per D'Olivo and McCulloch (2022).

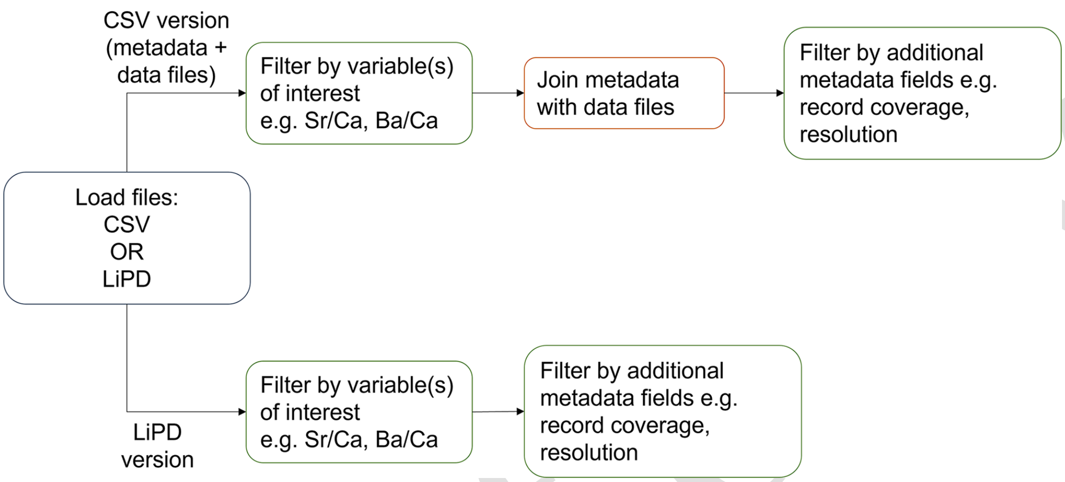

Figure 2. Flow chart of best practice handling of the two database file versions.

tral GBR region (17 to 20° S), 74 records are from the southern GBR (20 to 24° S), and 18 records are from the northern GBR (11 to 17° S).

Most records (58.2 %) have a maximum (core-top) age between 2000 and 2017 CE, and 73.1 % have a maximum age between 1990–2017 CE. The peak density of records occurs in the 1980s with ≥ 105 records in each year between 1980–1984 and nearly as many (≥ 100) in the early 1990s (1990–1993) (Fig. 2). Only 59 (28.4 %) of the records have a minimum age that occurs before 1900 CE, and 18 of those records are fossil coral records that range from ∼ 2296 to 5885 years BCE. Of these fossil records, 16 (88.9 %) are from the central GBR and 2 are from the southern GBR.

Of the 140 records measuring trace elements in the GBRCD, 49.3 % of records are a result of the development of laser ablation methods. There have been 69 LA-ICP-MS trace-element records published and 71 trace-element records analysed by other mass spectrometry methods. Many (54 records) of the non-LA-ICP-MS records are from studies that assess or use SST proxies, likely due to the expectation that trace-element records from laser ablation methods have a poorer fit with SST than TE records derived from solution methods. For example, the Wu et al. (2021b) LA-ICP-MS study found a notable poor periodicity and Sr/Ca–SST relationship in two out of six records, which led them to suggest that the usefulness of LA-ICP-MS for Sr/Ca–SST analysis is potentially limited by the relatively larger LA-ICP-MS analytical error than other mass spectrometry methods.

The majority of records in the database include Sr/Ca measurements (118 of 208; Fig. 4), and 63 of these records are used in SST calibrations. The other variables measured most frequently include B/Ca (59 records), Ba/Ca (78 records; Fig. 4), Mg/Ca (73 records; Fig. 4), U/Ca (77 records; Fig. 4), and luminescence (57 records; Fig. 5). There are 51 isotope records, of which 27 include δ^{18}O records (Fig. 5), 17 include δ^{13}C, 15 include δ^{11}B, 6 include δ^{14}C, 5 include δ^{15}N (Fig. 5), 1 includes δ^{66}Zn, and 1 includes δ^{98}Mo. Additionally, there are 18 records measuring REEs (Fig. 5). Note that this number excludes records that only measure yttrium and no REEs.

The number and spatial distribution of Sr/Ca records (Fig. 4c) reflect the dual utility of the ratio as an SST proxy and as a method to determine the coral age model. Similarly, U/Ca (Fig. 4d) is also used as an SST proxy and to determine coral age models. When combined with other proxies (e.g. Sr/Ca), U/Ca may improve SST predictions (Wu et al., 2021b; DeCarlo et al., 2016). The B/Ca proxy is commonly measured in addition to target proxies rather than being the focus of the study. However, B/Ca has more recently been paired with δ^{11}B in studies examining pH to determine the dissolved inorganic carbon in the calcifying fluid. Mg/Ca has been measured relatively frequently (Fig. 4b), and while

Table 13. Calibration metadata for the CSV version of the GBRCD. Available information on the calibration of coral records to environmental variables, specifically SST. Note "*X*" is used to represent a list of variables as stated in the description.

Field name	Variable	Type	Description
calib_isSSTCalibrationCoral	SST calibration coral flag	logic	Indicates whether the coral was used in creating an SST calibration in the database. Includes records that have been used to create a composite record calibration.
calib_useSSTCalibration	SST calibration flag	logic	Indicates whether there is SST-Sr/Ca, SST-U/Ca, or SST-δ^{18}O calibration information in the database. Includes records for corals used to create calibration equations and where an SST calibration was applied (e.g. fossil corals).
calib_hasAlternateCalibration	Alternate calibration information flag	logic	Indicates whether there are additional or alternate calibration equation(s) available for the record that is not included in the database. Alternate calibration equations can include non-SST calibrations (e.g. luminescence-rainfall calibration equation), and where applicable, may be included in calibration notes.
calib_notes	Calibration notes	text	Unstructured description of calibration. Includes information about proxy–SST calibrations and proxy–other calibrations if relevant.
calib_isComposite	Composite calibration flag	logic	Indicates whether calibration is a composite from more than one record.
calib_compositeList	Composite calibration record list	text	List of coral IDs (if known) used for composite calibration.
calib_SSTdata	SST product	text	Description of SST dataset(s) used for proxy–SST calibration, and treatment where applicable. SST datasets include AIMS (Australian Institute of Marine Science), Extended Reconstructed SST (ERSST), Comprehensive Ocean-Atmosphere Data Set (COADS), Integrated global ocean station system (IGOSS), Great Barrier Reef Marine Park Authority (GBRMPA), Hadley Centre Sea Ice and SST (HadISST), NOAA/Reyn-Smith Optimum Interpolation SST (OISST). SST dataset version information is included if the information was available.
calib_fitPeriod	Calibration fit period	text	Time period used to fit coral proxy–SST calibration if known. Takes the form of [min year]–[max year].
calib_hasCentredEquation	Centred equation flag	logic	Indicates whether there is an equation based on centred (data minus data mean for whole or specified period of data).
calib_centredEquationNotes	Centred equation information	text	Provides information on centred equation including method, equation (as provided in publication) and r^2 for relevant proxy–SST calibrations.

Table 13. Continued.

Field name	Variable	Type	Description
calib_method	Regression method	text	Regression method used for the proxy–SST regression(s) in the publication. If >1 method used, the field lists the methods used for the regression values in the following fields (i.e. calibX_ equationIntercept, etc.). Regression methods include ordinary least squares (OLS), reduced major axis (RMA), and weighted least squares (WLS).
calibX_equationIntercept	Proxy–SST intercept	numeric	The proxy–SST calibration intercept published for the coral record. Calibration equations take the form proxy = slope · SST + intercept. (Units: [data units] $°C^{-1}$)* ($X = 1$ (Sr/Ca), 2 (U/Ca), 3 ($\delta^{18}O$))
calibX_equationSlope	Proxy–SST slope	numeric	The proxy–SST calibration slope published for the coral record. Calibration equations take the form proxy = slope · SST + intercept. (Units: [data units] $°C^{-1}$)* ($X = 1$ (Sr/Ca), 2 (U/Ca), 3 ($\delta^{18}O$))
calibX_equationSlopeUncertainty	Proxy–SST slope uncertainty	numeric	The proxy–SST calibration slope uncertainty published for the coral record. Calibration equations take the form proxy = slope*SST + intercept. (Units: [data units] $°C^{-1}$)* ($X = 1$ (Sr/Ca), 2 (U/Ca), 3 ($\delta^{18}O$))
calibX_equationR2	Proxy–SST calibration r^2	numeric	The proxy–SST calibration r^2 value published for the coral record.* ($X = 1$ (Sr/Ca), 2 (U/Ca), 3 ($\delta^{18}O$))

* Descriptions based on Walter et al. (2023) CoralHydro2k database fields.

known as an SST proxy in other genera, the Mg/Ca–SST relationship in *Porites* spp. is weak or results are highly variable (e.g. Sadler et al., 2014; Wu et al., 2021b), possibly due to the coral actively discriminating against Mg^{2+} during biomineralisation (Marchitto et al., 2018). Ba/Ca (Fig. 4a) is frequently measured in the GBR, primarily to assess terrigenous inputs and river flow, and is mainly measured by LA-ICP-MS (58 of 78 Ba/Ca records).

Despite the widespread analysis of coral $\delta^{18}O$ across the tropical Pacific (∼ 100 $\delta^{18}O$-only and paired Sr/Ca-$\delta^{18}O$ records; Walter et al., 2023), there are few (only 27) $\delta^{18}O$ records available for the GBR (Fig. 5a), especially considering the length of time $\delta^{18}O$ has been used as an SST or hydrological proxy. This is potentially due to the paired forcing (SST and hydrology) that determines the coral $\delta^{18}O$ for nearshore corals, as well as the development and use of coral luminescence for assessing freshwater inputs into the GBR. Records including luminescence measurements make up 27.4 % of the GBRCD (Fig. 5b).

5 Discussion

There has been a push for coral records to include a range of details to meet minimum reporting standards for palaeoarchive records (such as MARPA (Dassié et al., 2017) and PaCTS (Khider et al., 2019)). These community-led publications report the ideal metadata that should be supplied with the publication of each record and provide a useful guide for best practice. The call for minimum reporting standards for data and metadata is echoed here. A particular challenge in producing the GBRCD was that metadata were often spread across multiple publications. To improve traceability between publications, relevant metadata could be included in the Supplement and in a publicly available data repository. The addition of IGSNs to capture the metadata associated with the physical samples would also improve the utility of the coral data (Dassié et al., 2017).

Another area for improvement is the reporting of screening corals for diagenesis. Diagenesis is a known source of error in geochemical analysis as it can remove the primary coral proxy signal (Hendy et al., 2007; Sayani et al., 2011; McGregor and Gagan, 2003; Nothdurft et al., 2007; Quinn

Table 14. Publication metadata. Publication details for one to three publications linked with the coral record. Note "X" is used to represent number from the list of variables as stated in the description.

Field name	Variable	Type	Description
pubX_firstauthor	First author	text	First author of publication ($X = 1, 2, 3$).*
pubX_year	Publication year	numeric	Year of publication ($X = 1, 2, 3$).*
pubX_doi	DOI	text	DOI of publication ($X = 1, 2, 3$).*
pubX_citation	Full citation	text	Complete citation of publication ($X = 1, 2, 3$).* Form is based on the Harvard reference style.
pubX_authors	Full author list	text	Full list of authors (in the order published) from each publication ($X = 1, 2, 3$), including the first listed author.
pubX_title	Title	text	Title of publication ($X = 1, 2, 3$).*
pubX_journal	Journal	text	Journal of publication ($X = 1, 2, 3$).*
pubX_doiData	Data DOI	text	DOI for dataset(s) ($X = 1, 2, 3$).
pubX_altDataURL	Alternate Data URL	text	Alternate/additional DOI or links to published data related to the coral record.
pub_isCoreIDOtherStudy	Core used in other studies	logic	Indicates if coral core ID was known to be used in other studies. Other studies may or may not be included in the database as the study data might not have been available or might be data that does not meet the GBRCD selection criteria (e.g. coral growth studies). If the core ID supplied was ambiguous (i.e. was the site location name), then it was not linked with other studies. Flag is to best of knowledge and may not be definitive.
pub_coreIDOtherStudyList	Publications of alternate studies of core	text	List of references where core has been used. Reference is in short form and full list is in the Table A1. List is to best of knowledge and may not be definitive.

* Descriptions based on Walter et al. (2023) CoralHydro2k database fields.

and Taylor, 2006; Weerabaddana et al., 2024). Only 40 of 208 records in the GBRCD reported on diagenetic alteration. The majority fail to mention the screening method(s) or outcomes (see "meths_archiveDiagenesisCheck") in the publication text or supplementary materials, or they could not be determined from cross-referencing sample IDs in other publications. There is no established standard of best practice for screening corals for diagenesis at present, though it is suggested that it is ideal to use petrographic analysis with a combination of methods, such as XRD and densitometry (McGregor and Abram, 2008). Other emerging approaches (e.g. Murphy et al., 2017; Takada et al., 2017) may also be useful for diagenesis screening. However, due to the strengths and weaknesses of the various methods as noted by Nothdurft and Webb (2009), examination by petrographic analysis (preferably using scanning electron microscopy) is required to confirm the type and level of diagenetic alteration (if any) present in a sample. Given the consequences of diagenesis for palaeoclimate and palaeoenvironment reconstructions from coral records, we strongly advocate for authors to report their diagenetic screening methods in their publications or supplements.

X-ray radiographs (X-radiographs hereafter) showing sampling paths should also be routinely published with the data, either as a figure in the paper or as supplementary material. Pioneering work on corals from the GBR showed that it is essential for corals to be sampled along the maximum growth axis. Providing this information was previously common (Alibert and McCulloch, 1997; Calvo et al., 2007; Pelejero et al., 2005; Chakraborty et al., 2000; DeLong et al., 2007), but x-radiographs have not been published consistently in recent years. Computed tomography (CT) scans of coral cores are sometimes used instead of, or in addition to, X-radiographs. Unlike X-radiographs, CT scans can be run

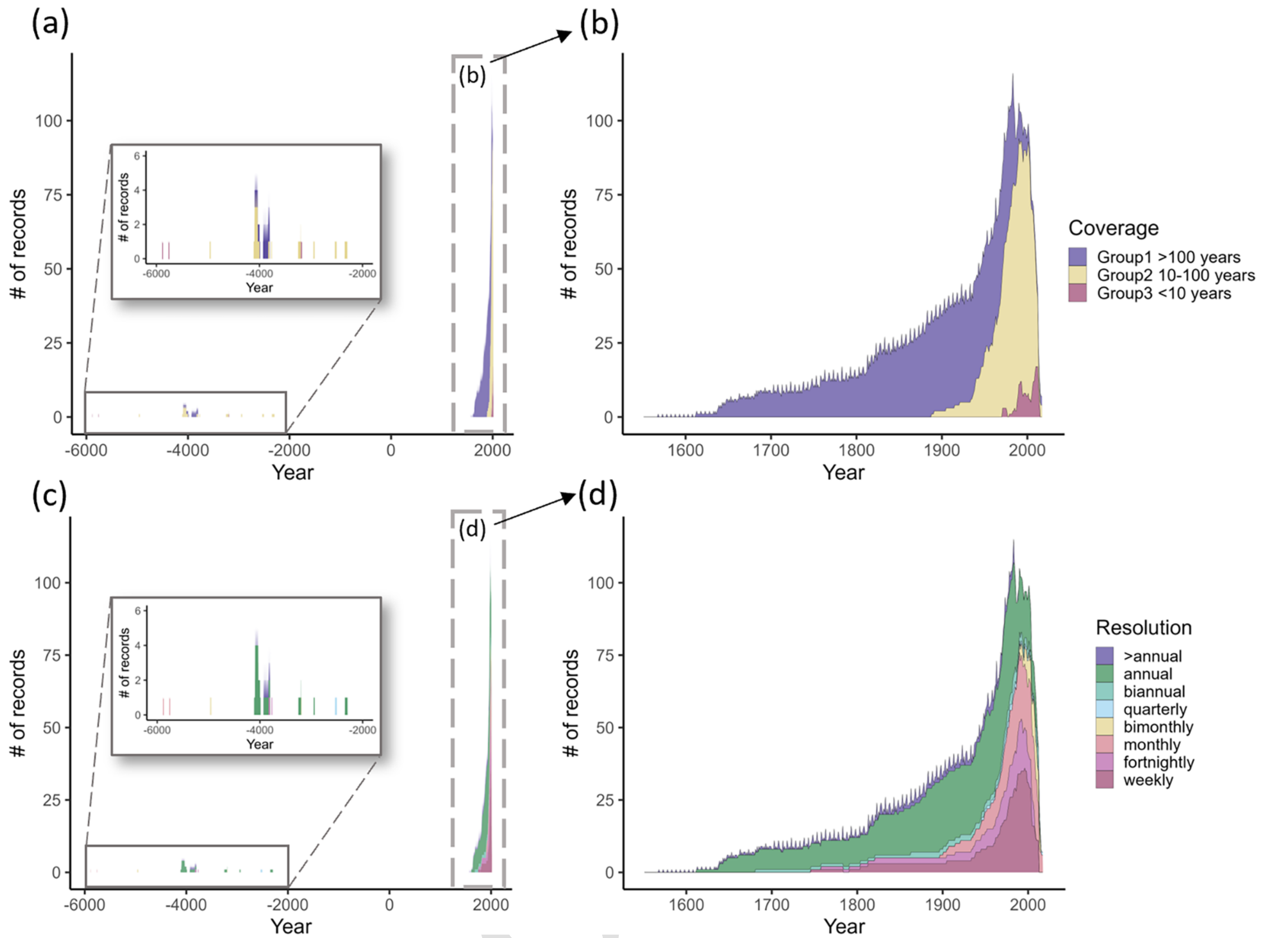

Figure 3. Temporal coverage of records in the GBRCD colour coded by **(a)** record coverage Group 1–3 as per Table 6 (1: records > 100 years; 2: records > 10 to < 100 years; 3: records < 10 years), includes an inset that enlarges the period −6000 to −2000 CE, **(b)** subset of **(a)** showing only records since 1550 CE, **(c)** nominal resolution as per Table 11 (see figure legend) (records with "_uneven" nominal resolution were combined with even resolution records), includes an inset that enlarges the period −6000 to −2000 CE, and **(d)** subset of **(c)** showing only records since 1550 CE. The "spikiness" visible in **(b)** Group 1 and **(d)** > annual resolution records is due to the combination of biennial and quinquennial resolution records. TS8

on uncut coral cores and drill core matrices, and similar to X-radiographs, they can provide information about extension rates, density, and calcification (Bosscher, 1993; Mollica et al., 2018; Crook et al., 2013), as well as growth morphologies and bioerosion (Prouty et al., 2017; DeCarlo et al., 2015; Li et al., 2021). As with X-radiographs, the CT scan images providing relevant information should be included with the paper.

With the continued passage of time, it is likely there will be further loss of existing coral records, physical samples, and associated data. Due to physical misplacement or destruction of data files, inability to read old computer files, and/or retirement of researchers with existing records, the coral data underpinning early coral research may be lost forever. We urge researchers in possession of existing records to reach out to archival teams such as those sustaining existing databases (e.g. the GBRCD or the CoralHydro2k database; Walter et al., 2023) to ensure records are archived for future use. An email address for submissions to the GBRCD is provided at the GBRCD GitHub and NOAA/WDS Paleoclimatology study page to facilitate capture of legacy or new coral data.

The GBRCD lends itself to meeting some of the suggestions put forward by Lough (2004) to improve the use of corals for palaeoclimatology. While not absolute replication, the GBRCD facilitates using multiple records to determine common environmental signals and identify non-climatic artefacts in those records. For example, the database enables combining multiple records to assess trends, similar to methods used by Hendy et al. (2002).

The long and comprehensive history of coral research on the GBR can make it difficult to find relevant research and records to understand the current state of coral palaeoclimate

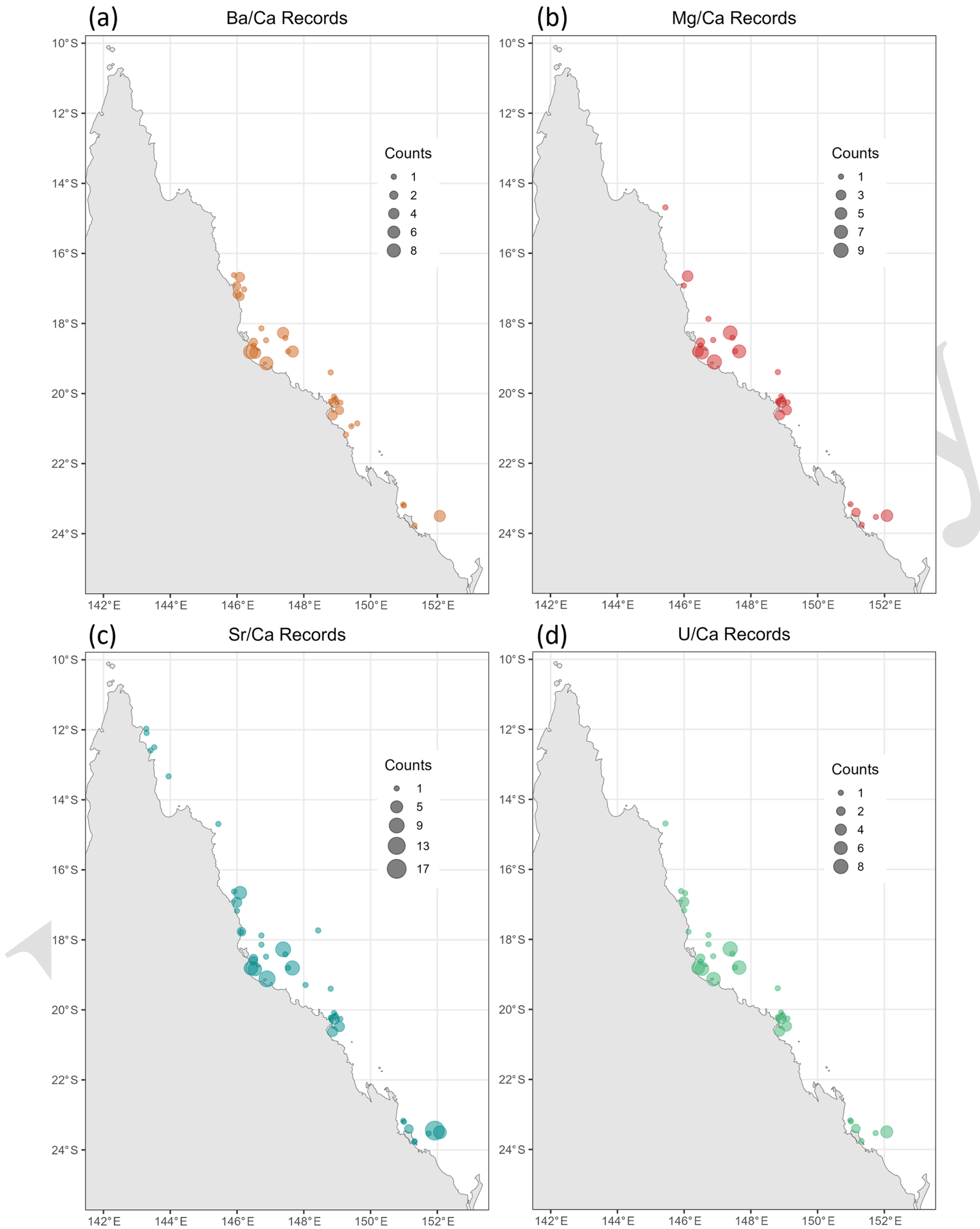

Figure 4. Location map of GBRCD records for common major trace-element ratios: **(a)** Ba/Ca, **(b)** Mg/Ca, **(c)** Sr/Ca, and **(d)** U/Ca. The size of the point indicates the number of records, and it is specific to each map.

and palaeoenvironment studies on the GBR and thus identify gaps in existing research. The GBRCD can be used to discern where future coral proxy records are needed. Additionally, the database includes 67 duplicate core names, which generally indicates different types of analyses on the same coral head and may provide an opportunity for comparisons between methods.

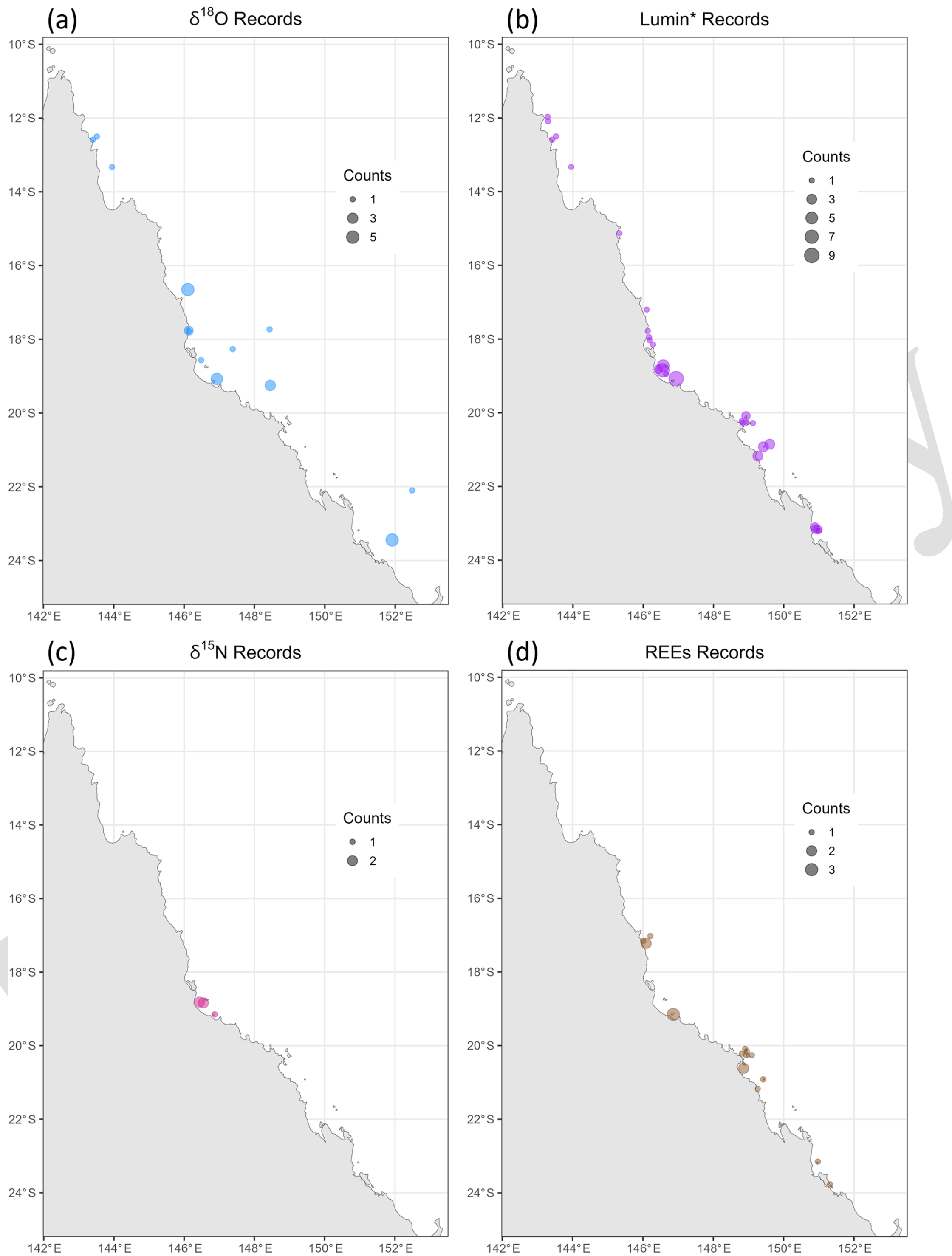

Figure 5. Location map of GBRCD records for **(a)** $\delta^{18}O$, **(b)** luminescence (Lumin), **(c)** $\delta^{15}N$, and **(d)** rare earth elements (REEs). The size of the point indicates the number of records, and it is specific to each map. Note that Lumin* includes all the methods included in the GBRCD for measuring luminescence.

The GBRCD can be used for analysis and examination of trends at local to regional scales. Records from the GBR database can be selectively used alongside other datasets to assess the past environment of Australia and/or the Pacific and identify trends and periods of note. It enables comparisons of different periods, such as the modern corals and older Holocene coral records, making it possible to identify notable changes between the time periods. Furthermore, records from the GBRCD can be combined with new and existing models of the palaeoenvironment.

6 Data availability

This is stage 1 of the GBRCD. The database is archived on the NOAA/WDS Paleoclimatology website. To access the database, visit https://doi.org/10.25921/hqxk-8h74 (Arzey et al., 2024) and click on the "NOAA Study Page" link. Example scripts to help users access the database, in either format, are available on the NOAA/WDS Paleoclimatology study page.

7 Interactive computing environment

Example scripts and database information are also available on the GBRCD GitHub page (https://github.com/arzeyak/GBR-Coral-Skeletal-Records-DatabaseTS10, last access: TS11; GBRCD, 2024).

Future updates to the database are expected to occur on an annual basis. We welcome submission of historic GBR coral record data for inclusion in the GBRCD, including existing unpublished datasets, supporting FAIR data principles (Wilkinson et al., 2016). Submitted records should meet general criteria outlined above in "Selection criteria for inclusion in GBRCD" (Sect. 2.1). For researchers that want to submit records (published or unpublished) to the GBRCD, please check the GBRCD GitHub page for details on how to submit your records for the database via the email address available on the GBRCD GitHub page and NOAA/WDS Paleoclimatology study page.

7 Conclusions

The GBRCD promotes efforts to ensure important research data are archived and that existing coral records are not lost to time. In conclusion, we note the following:

1. The GBRCD is a comprehensive database of coral records from the GBR produced and published since the early 1990s, as well as seven new records that are first published here. The database archives 208 coral records that are publicly available at NOAA/WDS Paleoclimatology.

2. Records have been standardised and converted to a machine-readable format that is easy to use to investigate the database and to select records of interest for analysis. With detailed metadata in the GBRCD, there are many avenues for investigating the past and present GBR environment.

3. There is scope in the future for improving the archiving of coral research datasets by building on the GBRCD and including the minimum recommended metadata information for traceability and use.

Appendix A: GBRCD records

Table A1. Reference data for publications cited in the GBRCD. Primary and secondary variables are the variable name as per Table 4. Citations in the "Record publication(s)" columns are listed in the order presented in the database (pub1; pub2; pub3). Citations in the "Additional core publication(s)" column are listed in alphanumerical order.

Dataset ID	Core name	Latitude	Longitude	Location	Primary variables (secondary variables)	Record publication(s)	Additional core publication(s)
AL03DAV01_1	Davies 2 (side)	−18.8	147.7	Davies Reef	Sr/Ca (Distance)	Alibert et al. (2003), Alibert and McCulloch (1997)	Fallon (2000), Fallon et al. (2003)
AL03DAV01_2	Davies 2 (side)	−18.8	147.7	Davies Reef	Ba; Ba/Ca; Cd; Mn; Mn/Ca; P; Y (Distance)	Alibert et al. (2003)	Alibert and McCulloch (1997), Fallon (2000), Fallon et al. (2003)
AL03PAN01_1	PAN 98-2 (B3)	−18.8	146.4	Pandora Reef	Sr/Ca (Distance)	Alibert et al. (2003)	
AL03PAN01_2	PAN 98-2 (B3)	−18.8	146.4	Pandora Reef	Ba/Ca; Mn; P (Distance)	Alibert et al. (2003)	
AL03PAN01_3	PAN 98-2 (B1)	−18.8	146.4	Pandora Reef	Ba/Ca; Cd; Mn; P; Y (Distance)	Alibert et al. (2003)	
AL03PAN01_4	PAN 98-2 (B1)	−18.8	146.4	Pandora Reef	Ba/Ca; Cd; Mn; Mn/Ca; P; Y (Distance)	Alibert et al. (2003)	
AR24DIP01	Dip-04	−18.414	147.448	Dip Reef	Ba/Ca; Mg/Ca; Sr/Ca; U/Ca; Y/Ca (Distance)	This study	
AR24OTI01	GUT12	−23.5053	152.0923	One Tree Island	Ba/Ca; Sr/Ca (Distance)	This study	
AR24OTI02	OTI 1-3	−23.499	152.072	One Tree Island	Ba/Ca; B/Ca; Ca/Ca; Mg/Ca; Sr/Ca; U/Ca (Distance)	This study	
AR24OTI03	OTI 3-1	−23.499	152.072	One Tree Island	Ba/Ca; B/Ca; Ca/Ca; Mg/Ca; Sr/Ca; U/Ca (Distance)	This study	
AR24OTI04	OTI4_6C (OTI-4-19-6C)	−23.499	152.072	One Tree Island	Ba/Ca; B/Ca; Ca/Ca; Mg/Ca; Sr/Ca; U/Ca (Distance)	This study	
AR24OTI05	OTI4_6D (OTI-4-22-6D)	−23.499	152.072	One Tree Island	Ba/Ca; B/Ca; Ca/Ca; Mg/Ca; Sr/Ca; U/Ca (Distance)	This study	
AR24SLY01	SR	−19.25	149.1167	Stanley Reef	$\delta^{13}C$; $\Delta^{14}C$; $\delta^{18}O$	This study	Chakraborty (1993); Chakraborty et al. (2000)

Table A1. Continued.

Dataset ID	Core name	Latitude	Longitude	Location	Primary variables (secondary variables)	Record publication(s)	Additional core publication(s)
BR17HER01	GBR-637	−23.442	151.914	Heron Island	$\delta^{18}O$; Sr/Ca	Brenner et al. (2017)	
BR17HER02	GBR-641A	−23.442	151.914	Heron Island	$\delta^{18}O$; Sr/Ca	Brenner et al. (2017)	
BR17HER03	GBR-538	−23.442	151.914	Heron Island	$\delta^{18}O$; Sr/Ca	Brenner et al. (2017)	
BR17HER04	HER-1F (HER-OR)	−23.442	151.914	Heron Island	$\delta^{18}O$; Sr/Ca	Brenner et al. (2017)	
BR17HER05	HER-13 (HER12-13)	−23.442	151.914	Heron Island	$\delta^{18}O$; Sr/Ca	Brenner et al. (2017)	Linsley et al. (2019)
CA07FLI01	Flinders (FLI02A)	−17.73	148.43	Flinders Reef	$\delta^{18}O$; Sr/Ca	Calvo et al. (2007)	Pelejero et al. (2005)
CH93SLY01	SR	−19.25	148.1167	Stanley Reef	$\delta^{13}C$; $\delta^{18}O$ (Density; Distance)	Chakraborty (1993), Chakraborty et al. (2000)	
CH93SLY02	SR	−19.25	148.1167	Stanley Reef	$\delta^{13}C$; $\delta^{18}O$ (Density; Distance)	Chakraborty (1993), Chakraborty et al. (2000)	
DE14ARL01	10AR1	−16.6381	146.1036	Arlington Reef	$\delta^{13}C$; $\delta^{18}O$; Mg/Ca; Sr/Ca ($\delta^{18}O_{seawater}$; Extension)	Deng et al. (2014)	
DE14ARL02	10AR2	−16.6381	146.1036	Arlington Reef	$\delta^{13}C$; $\delta^{18}O$; Mg/Ca; Sr/Ca ($\delta^{18}O_{seawater}$; Extension)	Deng et al. (2014), Wang et al. (2019)	Chen et al. (2021), Xiao et al. (2020)
DO15GBR01	1709_6	−17.876	146.729	Reef 17-065	$\delta^{11}B$	D'Olivo et al. (2015)	D'Olivo et al. (2018)
DO15HAV01	HAV09_3	−18.836	146.5259	Havannah Island	$\delta^{11}B$	D'Olivo et al. (2015)	D'Olivo and McCulloch (2017), D'Olivo et al. (2013, 2018)
DO15HAV02	HAV09_3	−18.836	146.5259	Havannah Island	$\delta^{11}B$	D'Olivo et al. (2015), Chen et al. (2021)	D'Olivo and McCulloch (2017), D'Olivo et al. (2013, 2018)
DO15HAV03	HAV06A	−18.84	146.54	Havannah Island	$\delta^{11}B$	D'Olivo et al. (2015), Chen et al. (2021)	D'Olivo et al. (2013)
DO15PAN01	PAN02 (PAN02A)	−18.81	146.43	Pandora Reef	$\delta^{11}B$	D'Olivo et al. (2015), Chen et al. (2021)	D'Olivo et al. (2013)
DO15RIB09	RIB09_3	−18.48	146.87	Rib Reef	$\delta^{11}B$	D'Olivo et al. (2015)	D'Olivo et al. (2013, 2018)
DO17HAV01	HAV09_3 (Path A)	−18.836	146.5259	Havannah Island	$\delta^{11}B$ (Extension)	D'Olivo and McCulloch (2017)	D'Olivo et al. (2015, 2018)

Table A1. Continued.

Dataset ID	Core name	Latitude	Longitude	Location	Primary variables (secondary variables)	Record publication(s)	Additional core publication(s)
DO17HAV02	HAV09_3 (Path B)	−18.836	146.5259	Havannah Island	B/Ca; δ^{11}B; Li/Ca; Li/Mg; Mg/Ca; Sr/Ca; U/Ca (Extension)	D'Olivo and McCulloch (2017)	D'Olivo et al. (2015, 2018)
DO17HAV03	HAV09_3 (Path C)	−18.836	146.5259	Havannah Island	B/Ca; δ^{11}B; Li/Ca; Li/Mg; Mg/Ca; Sr/Ca; U/Ca (Extension)	D'Olivo and McCulloch (2017)	D'Olivo et al. (2015, 2018)
DO17HAV04	HAV09_3 (Path D)	−18.836	146.5259	Havannah Island	B/Ca; δ^{11}B; Li/Ca; Li/Mg; Mg/Ca; Sr/Ca; U/Ca (Extension)	D'Olivo and McCulloch (2017)	D'Olivo et al. (2015, 2018)
DO18DAV01	DAV-1 (DAV09_2)	−18.83	147.63	Davies Reef	B/Ca; Li/Ca; Li/Mg; Mg/Ca; Sr/Ca; U/Ca	D'Olivo et al. (2018)	
DO18DAV02	DAV-2 (DAV13_2)	−18.8	147.63	Davies Reef	B/Ca; Li/Ca; Li/Mg; Mg/Ca; Sr/Ca; U/Ca	D'Olivo et al. (2018)	McCulloch et al. (2017), Thompson et al. (2022)
DO18DAV03	DAV-3 (DAV13_3)	−18.8	147.63	Davies Reef	B/Ca; Li/Ca; Li/Mg; Mg/Ca; Sr/Ca; U/Ca	D'Olivo et al. (2018)	McCulloch et al. (2017), Thompson et al. (2022)
DO18FIT01	FITZ (FZ04B)	−16.923	145.993	Fitzroy Island	B/Ca; Li/Ca; Li/Mg; Mg/Ca; Sr/Ca; U/Ca	D'Olivo et al. (2018)	D'Olivo and McCulloch (2022)
DO18GBR01	CORE-17 (1709_6)	−17.876	146.729	Reef 17-065	B/Ca; Li/Ca; Li/Mg; Mg/Ca; Sr/Ca; U/Ca	D'Olivo et al. (2018)	
DO18HAV01	HAV (HAV09_3)	−18.836	146.5259	Havannah Island	B/Ca; Li/Ca; Li/Mg; Mg/Ca; Sr/Ca; U/Ca	D'Olivo et al. (2018)	D'Olivo and McCulloch (2017)
DO18LIZ01	LIZ (LIZ13_1)	−14.69	145.44	Lizard Island	B/Ca; Li/Ca; Li/Mg; Mg/Ca; Sr/Ca; U/Ca	D'Olivo et al. (2018)	D'Olivo et al. (2015)
DO18MYR01	MYR-1 (MYR5_271)	−18.27	147.38	Myrmidon Reef	B/Ca; Li/Ca; Li/Mg; Mg/Ca; Sr/Ca; U/Ca	D'Olivo et al. (2018)	
DO18MYR02	MYR-2 (MYR13_2)	−18.27	147.38	Myrmidon Reef	B/Ca; Li/Ca; Li/Mg; Mg/Ca; Sr/Ca; U/Ca	D'Olivo et al. (2018)	
DO18MYR03	MYR-3 (MYR13_5)	−18.27	147.38	Myrmidon Reef	B/Ca; Li/Ca; Li/Mg; Mg/Ca; Sr/Ca; U/Ca	D'Olivo et al. (2018)	

Table A1. Continued.

Dataset ID	Core name	Latitude	Longitude	Location	Primary variables (secondary variables)	Record publication(s)	Additional core publication(s)
DO18MYR04	MYR-4 (MYR13_7)	−18.27	147.38	Myrmidon Reef	B/Ca; Li/Ca; Li/Mg; Mg/Ca; Sr/Ca; U/Ca	D'Olivo et al. (2018)	
DO18RIB01	RIB (RIB09_3)	−18.48	146.87	Rib Reef	Ba/Ca; B/Ca; B/Mg; Li/Ca; Li/Mg; Mg/Ca; Sr/Ca; U/Ca	D'Olivo et al. (2018)	D'Olivo et al. (2015)
DO22ARL01	AER04-1	−16.68	146.03	Arlington Reef	Ba^{138}/Ca; Ba/Ca; Sr/Ca; U/Ca	D'Olivo and McCulloch (2022)	
DO22BRT01	BRT01	−18.14	146.73	Britomart Reef	Ba/Ca; Sr/Ca; U/Ca	D'Olivo and McCulloch (2022)	
DO22FIT01	FZ04B-1	−16.93	145.99	Fitzroy Island	Ba^{138}/Ca; Ba/Ca; Sr/Ca; U/Ca	D'Olivo and McCulloch (2022)	D'Olivo et al. (2018)
DO22FIT02	FZ04-2	−16.93	145.99	Fitzroy Island	Ba^{138}/Ca; Ba/Ca; Sr/Ca; U/Ca	D'Olivo and McCulloch (2022)	
DO22HIG01	HI03-1	−17.17	146	High Island	Ba^{138}/Ca; Ba/Ca; Sr/Ca; U/Ca	D'Olivo and McCulloch (2022)	
DO22HMP01	HMP01B	−23.2	151	Humpy Island	Ba/Ca; Sr/Ca; U/Ca	D'Olivo and McCulloch (2022)	Lough (2007, 2011a, b)
DO22MAG01	MAG01D	−19.15	146.87	Geoffrey Bay, Magnetic Island	Ba^{138}/Ca; Ba/Ca; Sr/Ca; U/Ca	D'Olivo and McCulloch (2022)	Barnes and Lough (1992), De'ath et al. (2009), Erler et al. (2016), Lewis (2005), Lewis et al. (2007), Lough (2007, 2011a, b), Lough and Barnes (1997)
DO22OYS01	OY04-3	−16.62	145.91	Oyster Reef	Ba^{138}/Ca; Ba/Ca; Sr/Ca; U/Ca	D'Olivo and McCulloch (2022)	
DO22PAN01	PAN08-1	−18.82	146.43	Pandora Reef	Ba^{138}/Ca; Ba/Ca; Sr/Ca; U/Ca	D'Olivo and McCulloch (2022)	D'Olivo et al. (2013)
DO22PAN02	PAN08-2	−18.82	146.43	Pandora Reef	Ba^{138}/Ca; Ba/Ca; Sr/Ca; U/Ca	D'Olivo and McCulloch (2022)	D'Olivo et al. (2013)
DR95LMI01	Lady Musgrave	−23.9	152.38	Lady Musgrave Island	Δ14C	Druffel and Griffin (1995)	
DR99ABR01_1	Abraham-1 (99aust02a)	−22.1	152.48	Abraham Reef	$\delta^{13}C$; $\delta^{18}O$	Druffel and Griffin (1999, 1995, 1993)	Linsley et al. (2019)
DR99ABR01_2	Abraham-1 (99aust02a)	−22.1	152.48	Abraham Reef	Δ14C	Druffel and Griffin (1999, 1995, 1993)	Linsley et al. (2019)

Table A1. Continued.

Dataset ID	Core name	Latitude	Longitude	Location	Primary variables (secondary variables)	Record publication(s)	Additional core publication(s)
DR99ABR02	Abraham-2 (99aust02b)	−22.1	152.48	Abraham Reef	Δ14C	Druffel and Griffin (1999, 1995, 1993)	
DR99HER01	Heron (99aust03a)	−23.44	151.98	Heron Island	Δ14C	Druffel and Griffin (1999, 1995)	
EL19OTI01	PET12	−23.4873	152.0814	Pete's Bay, One Tree Island	Ba^{138}/Ca; Ba/Ca; B/Ca; Cd/Ca; Fe/Ca; Li/Ca; Mg/Ca; Mn/Ca; Pb/Ca; P/Ca; Sr/Ca; U/Ca; Y/Ca	Ellis et al. (2019)	
ER16MAG01	MAG01D	−19.15	146.87	Geoffrey Bay, Magnetic Island	$\delta^{15}N$; $\delta^{18}O$ (Calcification; Density; Extension)	Erler et al. (2016, 2020)	Barnes and Lough (1992), D'Olivo and McCulloch (2022), De'ath et al. (2009), Lewis (2005), Lewis et al. (2007), Lough (2011a, b), Lough and Barnes (1997)
ER20HAV01	HAV01A	−18.837	146.548	Havannah Island	$\delta^{15}N$	Erler et al. (2020)	D'Olivo and McCulloch (2022), De'ath et al. (2009), Hendy et al. (2002, 2003a, b, 2007, 2012), Isdale et al. (1998), Lough (2007, 2011a, b), Lough and Barnes (1997), Lough et al. (2015), McCulloch et al. (2003), Palmer et al. (2015)
ER20HAV02	Hav33a (Hav33b)	−18.837	146.548	Havannah Island	$\delta^{15}N$	Erler et al. (2020)	
ER20PAN01	Pan04b	−18.815	146.436	Pandora Reef	$\delta^{15}N$	Erler et al. (2020)	De'ath et al. (2009), Lough (2007), Lough and Barnes (1997)
ER20PAN02	Pan22b	−18.815	146.436	Pandora Reef	$\delta^{15}N$	Erler et al. (2020)	Cantin and Lough (2014), De'ath et al. (2009)
FA00PAN01	Pandora 1-98 (b)	−18.8	146.4	Pandora Reef	Ba/Ca; B/Ca; Mg/Ca; Sr/Ca; U/Ca (Distance)	Fallon (2000)	

Table A1. Continued.

Dataset ID	Core name	Latitude	Longitude	Location	Primary variables (secondary variables)	Record publication(s)	Additional core publication(s)
FA03DAV01	Davies 2	−18.8	147.7	Davies Reef	Ba/Ca; B/Ca; Mg/Ca; Mn; Sr/Ca; U/Ca (Distance)	Fallon et al. (2003), Fallon (2000)	Alibert and McCulloch (1997), Alibert et al. (2003)
FA03DAV02	Davies 8	−18.8	147.7	Davies Reef	Ba/Ca; B/Ca; Mg/Ca; Mn; Sr/Ca; U/Ca (Distance)	Fallon et al. (2003), Fallon (2000)	Alibert and McCulloch (1997)
FA03HAV01	Havannah Island	−18.843	146.537	Havannah Island	Ba/Ca; B/Ca; Mg/Ca; Mn; Sr/Ca; U/Ca (Distance)	Fallon et al. (2003, Fallon (2000)	
FA03MYR01	Myrmidon 2 (Myr-2)	−18.266	147.383	Myrmidon Reef	Ba/Ca; B/Ca; Mg/Ca; Mn; Sr/Ca; U/Ca (Distance)	Fallon et al. (2003), Fallon (2000)	Marshall and McCulloch (2002)
FA03ORP01	Orpheus Island	−18.634	146.495	Orpheus Island	Ba/Ca; B/Ca; Mg/Ca; Mn; Sr/Ca; U/Ca (Distance)	Fallon et al. (2003), Fallon (2000)	
FA03PAN01	Pandora 1-98 (a)	−18.8	146.4	Pandora Reef	Ba/Ca; B/Ca; Mg/Ca; Mn; Sr/Ca; U/Ca (Distance)	Fallon et al. (2003), Fallon (2000)	
FA03WHE01	Wheeler Reef	−18.799	147.528	Wheeler Reef	Ba/Ca; B/Ca; Mg/Ca; Sr/Ca; U/Ca (Distance)	Fallon et al. (2003), Fallon (2000)	Alibert and McCulloch (1997)
GA98ORP01	OR-1	−18.567	146.483	Iris Point, Orpheus Island	δ^{18}O; Sr/Ca ($\delta^{18}O_{seawater}$)	Gagan et al. (1998, 2002, 1994)	Gagan et al. (2012)
HE02GBR01	NA	−17.78	146.13	Central GBR	δ^{18}O; Sr/Ca; U/Ca ($\delta^{18}O_{seawater}$)	Hendy et al. (2002, 2007)	
HE03GBR01	NA	−17.78	146.13	Central GBR	Luminescence visual indices	Hendy et al. (2003a)	
HE03GPI01	GPI-02A-01 (GPI02A)	−18.733	146.567	Great Palm Island	Luminescence visual indices	Hendy et al. (2003a, 2007), Leonard et al. (2016)	De'ath et al. (2009), Hendy et al. (2002, 2003b), Leonard et al. (2016), Lough (2007, 2011a, b), Lough and Barnes (1997)

Table A1. Continued.

Dataset ID	Core name	Latitude	Longitude	Location	Primary variables (secondary variables)	Record publication(s)	Additional core publication(s)
IS98HAV02	Havannah (HAV01A)	−18.85	146.55	Havannah Island	Luminescence Sum	Isdale et al. (1998)	D'Olivo and McCulloch (2022), De'ath et al. (2009), Erler et al. (2020); Hendy et al. (2002, 2003a, b, 2007, 2012), Lough (2007, 2011a, b), Lough and Barnes (1997), Lough et al. (2015), McCulloch et al. (2003), Palmer et al. (2015)
IS98PAN01	Pandora (PAN08B)	−18.82	146.43	Pandora Reef	Luminescence Sum	Isdale et al. (1998)	Hendy et al. (2002), Hendy et al. (2003a, b, 2007, 2012)
JU08KES01a	KIB	−20.9177	149.4178	Keswick Island	Luminescence	Jupiter et al. (2008)	
JU08KES01b	KIA	−20.9177	149.4186	Keswick Island	Ce; Dy; Er; Eu; Gd; Ho; La; Lu; Nd; Pr; Sm; Tb; Tm; Y; Yb; Y/Ho	Jupiter (2008, 2006)	
JU08KES02	KIC	−20.9177	149.4178	Keswick Island	Luminescence	Jupiter et al. (2008)	Marion et al. (2021)
JU08KES03	KIE	−20.9319	149.4267	Keswick Island	Ba/Ca; Luminescence	Jupiter et al. (2008)	
JU08RTI01a	RTC	−21.1755	149.2639	Round Top Island	Luminescence	Jupiter et al. (2008)	Marion et al. (2021)
JU08RTI01b	RTF	−21.1708	149.2644	Round Top Island	Ce; Dy; Er; Eu; Gd; Ho; La; Lu; Nd; Pr; Sm; Tb; Tm; Y; Yb; Y/Ho	Jupiter (2008, 2006)	Marion et al. (2021)
JU08RTI02	RTH	−21.172	149.2639	Round Top Island	Ba/Ca; Luminescence	Jupiter et al. (2008)	Marion et al. (2021)
JU08RTI03	RTI	−21.1717	149.2634	Round Top Island	Luminescence	Jupiter et al. (2008)	
JU08SCA01	SCA	−20.8522	149.6021	Scawfell Island	Luminescence	Jupiter et al. (2008)	
JU08SCA02	SCB	−20.8522	149.6021	Scawfell Island	Luminescence	Jupiter et al. (2008)	
JU08SCA03	SCC	−20.8522	149.6021	Scawfell Island	Ba/Ca; Luminescence	Jupiter et al. (2008)	Marion et al. (2021)

Table A1. Continued.

Dataset ID	Core name	Latitude	Longitude	Location	Primary variables (secondary variables)	Record publication(s)	Additional core publication(s)
LE05MAG01	MAG01D	−19.15	146.858	Geoffrey Bay, Magnetic Island	$\delta^{13}C$; $\delta^{18}O$ ($\delta^{18}O_{seawater}$)	Lewis (2005)	Barnes and Lough (1992), D'Olivo and McCulloch (2022), De'ath et al. (2009); Erler et al. (2016), Lewis et al. (2007), Lough (2007, 2011a, b), Lough and Barnes (1997)
LE05NEL01	NEL01D	−19	147	Nelly Bay, Magnetic Island	$\delta^{13}C$; $\delta^{18}O$ ($\delta^{18}O_{seawater}$)	Lewis (2005)	Lewis et al. (2007), Lough et al. (2014)
LE05NEL02	NEL03D	−19	147	Nelly Bay, Magnetic Island	$\delta^{13}C$; $\delta^{18}O$ ($\delta^{18}O_{seawater}$)	Lewis (2005)	Lough et al. (2014)
LE07MAG01	MAG01D	−19.15	146.87	Geoffrey Bay, Magnetic Island	Ba; Ba/Ca; /Ca; Mg/Ca; Mn; Pr; Sm; Sr/Ca; Th; U/Ca; Y; Y/Ho (Distance)	Lewis et al. (2007), Lewis (2005)	Barnes and Lough (1992), D'Olivo and McCulloch (2022), De'ath et al. (2009), Erler et al. (2016), Lewis (2005), Lough (2007, 2011a, b), Lough and Barnes (1997)
LE07NEL01	NEL01D	−19	147	Nelly Bay, Magnetic Island	Ba; Ba/Ca; /Ca TS12; Mg/Ca; Mn; Pr; Sm; Sr/Ca; Th; U/Ca; Y; Y/Ho (Distance)	Lewis et al. (2007), Lewis (2005)	Lough et al. (2014)
LE12CID01	CID-01A	−20.3	148.9	Cid Harbour Island	Ba^{138}/Ca; Ba/Ca; B/Ca; Ca/Ca; Cd; Cd/Ca; Li/Ca; Mg/Ca; Mn; Mn/Ca; P; Pb/Ca; P/Ca; Sr/Ca; U/Ca; Y; Y/Ca (Distance)	Lewis et al. (2012)	De'ath et al. (2009), Lough (2007, 2011a, b), Lough and Barnes (1997)
LE12CID02	CID-71B	−20.254	148.923	Cid Harbour Island	Ba^{138}/Ca; Ba/Ca; B/Ca; Ca/Ca; Cd; Cd/Ca; Li/Ca; Mg/Ca; Mn; Mn/Ca; P; Pb/Ca; P/Ca; Sr/Ca; U/Ca; Y; Y/Ca (Distance)	Lewis et al. (2012)	

Table A1. Continued.

Dataset ID	Core name	Latitude	Longitude	Location	Primary variables (secondary variables)	Record publication(s)	Additional core publication(s)
LE12CID03	CID-73B	−20.253	148.92	Cid Harbour Island	Ba^{138}/Ca; Ba/Ca; B/Ca; Cd; Cd/Ca; Ce; Ce/Ca; Eu; Eu/Ca; Gd; Gd/Ca; La; La/Ca; Li/Ca; Lu; Lu/Ca; Mg/Ca; Mn; Mn/Ca; P; Pb/Ca; P/Ca; Pr; Pr/Ca; Sm; Sm/Ca; Sr/Ca; U/Ca; Y; Yb; Yb/Ca; Y/Ca; Zn/Ca	Lewis et al. (2012)	
LE12COB01	COB-71A	−19.396	148.806	Cobham Reef	Ba^{138}/Ca; Ba/Ca; B/Ca; Cd/Ca; Li/Ca; Mg/Ca; Mn/Ca; Pb/Ca; P/Ca; Sr/Ca; U/Ca; Y/Ca (Distance)	Lewis et al. (2012)	
LE12HAS01	HWD-73B	−20.26	149.096	Haslewood Island	Ba^{138}/Ca; Ba/Ca; B/Ca; Cd; Cd/Ca; Ce; Ce/Ca; Eu; Eu/Ca; Gd; Gd/Ca; La; La/Ca; Li/Ca; Lu; Lu/Ca; Mg/Ca; Mn; Mn/Ca; P; Pb/Ca; P/Ca; Pr; Pr/Ca; Sm; Sm/Ca; Sr/Ca; U/Ca; Y; Yb; Yb/Ca; Y/Ca; Zn/Ca (Distance)	Lewis et al. (2012)	
LE12HKO01	SNH-73A	−20.089	148.907	Stonehaven Bay, Hook Island	Ba^{138}/Ca; Ba/Ca; B/Ca; Cd; Cd/Ca; Ce; Ce/Ca; Eu; Eu/Ca; Gd; Gd/Ca; La; La/Ca; Li/Ca; Lu; Lu/Ca; Mg/Ca; Mn; Mn/Ca; P; Pb/Ca; P/Ca; Pr; Pr/Ca; Sm; Sm/Ca; Sr/Ca; U/Ca; Y; Yb; Yb/Ca; Y/Ca; Zn/Ca (Distance)	Lewis et al. (2012)	

Table A1. Continued.

Dataset ID	Core name	Latitude	Longitude	Location	Primary variables (secondary variables)	Record publication(s)	Additional core publication(s)
LE12NMI01	NMI-73A	−20.22	148.811	North Molle Island	Ba^{138}/Ca; Ba/Ca; B/Ca; Cd; Cd/Ca; Ce; Ce/Ca; Eu; Eu/Ca; Gd; Gd/Ca; La; La/Ca; Li/Ca; Lu; Lu/Ca; Mg/Ca; Mn; Mn/Ca; P; Pb/Ca; P/Ca; Pr; Pr/Ca; Sm; Sm/Ca; Sr/Ca; U/Ca; Y; Yb; Yb/Ca; Y/Ca; Zn/Ca (Distance)	Lewis et al. (2012)	
LE12REP01	REP-71A	−20.618	148.865	Repulse Island	Ba^{138}/Ca; Ba/Ca; B/Ca; Cd; Cd/Ca; Ce; Ce/Ca; La; La/Ca; Li/Ca; Lu; Lu/Ca; Mg/Ca; Mn; Mn/Ca; P; Pb/Ca; P/Ca; Pr; Pr/Ca; Sr/Ca; U/Ca; Y; Yb; Yb/Ca; Y/Ca; Zn/Ca (Distance)	Lewis et al. (2012)	
LE12REP02	REP-72A	−20.617	148.864	Repulse Island	Ba^{138}/Ca; Ba/Ca; B/Ca; Cd; Cd/Ca; Ce; Ce/Ca; La; La/Ca; Li/Ca; Lu; Lu/Ca; Mg/Ca; Mn; Mn/Ca; P; Pb/Ca; P/Ca; Pr; Pr/Ca; Sr/Ca; U/Ca; Y; Yb; Yb/Ca; Y/Ca; Zn/Ca (Distance)	Lewis et al. (2012)	
LE12REP03	REP-72B	−20.617	148.864	Repulse Island	Ba^{138}/Ca; Ba/Ca; B/Ca; Ca/Ca; Cd; Cd/Ca; Li/Ca; Mg/Ca; Mn; Mn/Ca; P; Pb/Ca; P/Ca; Sr/Ca; U/Ca; Y; Y/Ca (Distance)	Lewis et al. (2012)	

Table A1. Continued.

Dataset ID	Core name	Latitude	Longitude	Location	Primary variables (secondary variables)	Record publication(s)	Additional core publication(s)
LE12SHW01	SHW-82A	−20.48	149.069	Shaw Island	Ba^{138}/Ca; Ba/Ca; B/Ca; Cd; Cd/Ca; Li/Ca; Mg/Ca; Mn; Mn/Ca; P; Pb/Ca; P/Ca; Sr/Ca; U/Ca; Y; Y/Ca (Distance)	Lewis et al. (2012)	
LE12SHW02	SHW-83B	−20.48	149.069	Shaw Island	Ba^{138}/Ca; Ba/Ca; B/Ca; Cd; Cd/Ca; Li/Ca; Mg/Ca; Mn; Mn/Ca; P; Pb/Ca; P/Ca; Sr/Ca; U/Ca; Y; Y/Ca (Distance)	Lewis et al. (2012)	
LE12WHI01	WHI-34A	−20.169	148.957	Whitsunday Island	Ba^{138}/Ca; Ba/Ca; B/Ca; Cd; Cd/Ca; Ce; Ce/Ca; La; La/Ca; Li/Ca; Mg/Ca; Mn; Mn/Ca; P; Pb/Ca; P/Ca; Sr/Ca; U/Ca; Y; Y/Ca (Distance)	Lewis et al. (2012)	De'ath et al. (2009)
LE16GPI01	PAM2.0	−18.733	146.567	Great Palm Island	Luminescence visual indices	Leonard et al. (2016)	
LE16GPI02	PAM3.1	−18.733	146.567	Great Palm Island	Luminescence visual indices	Leonard et al. (2016)	
LE16GPI03	PAM5.0	−18.733	146.567	Great Palm Island	Luminescence visual indices	Leonard et al. (2016)	
LE18GFB01	GFB33B	−19.154	146.866	Geoffrey Bay, Magnetic Island	Ba^{138}/Ca; Ba/Ca; B/Ca; Cd/Ca; Li/Ca; Mg/Ca; Mn/Ca; Pb/Ca; P/Ca; Sr/Ca; U/Ca; Y/Ca (Distance)	Lewis et al. (2018), D'Olivo and McCulloch (2022)	Saha et al. (2019b, 2021)
LE18GFB02	GFB34A	−19.164	146.853	Geoffrey Bay, Magnetic Island	Ba^{138}/Ca; Ba/Ca; B/Ca; Cd/Ca; Li/Ca; Mg/Ca; Mn/Ca; Pb/Ca; P/Ca; Sr/Ca; U/Ca; Y/Ca (Distance)	Lewis et al. (2018), D'Olivo and McCulloch (2022)	

Table A1. Continued.

Dataset ID	Core name	Latitude	Longitude	Location	Primary variables (secondary variables)	Record publication(s)	Additional core publication(s)
LE18HAV01	HAV32A	−18.835	146.544	Havannah Island	Ba^{138}/Ca; Ba/Ca; B/Ca; Cd/Ca; Li/Ca; Mg/Ca; Mn/Ca; Pb/Ca; P/Ca; Sr/Ca; U/Ca; Y/Ca (Distance)	Lewis et al. (2018), D'Olivo and McCulloch (2022)	Lough et al. (2015)
LE18HAV02	HAV34A	−18.837	146.548	Havannah Island	Ba^{138}/Ca; Ba/Ca; B/Ca; Cd/Ca; Li/Ca; Mg/Ca; Mn/Ca; Pb/Ca; P/Ca; Sr/Ca; U/Ca; Y/Ca (Distance)	Lewis et al. (2018), D'Olivo and McCulloch (2022)	Lough et al. (2015)
LE18NEL01	NEL29A	−19.165	146.854	Nelly Bay, Magnetic Island	Ba^{138}/Ca; Ba/Ca; B/Ca; Cd/Ca; Li/Ca; Mg/Ca; Mn/Ca; Pb/Ca; P/Ca; Sr/Ca; U/Ca; Y/Ca (Distance)	Lewis et al. (2018), D'Olivo and McCulloch (2022)	Cantin and Lough (2014), De'ath et al. (2009), Lough et al. (2014)
LE18NEL02	NEL39A	−19.169	146.85	Nelly Bay, Magnetic Island	Ba^{138}/Ca; Ba/Ca; B/Ca; Cd/Ca; Li/Ca; Mg/Ca; Mn/Ca; Pb/Ca; P/Ca; Sr/Ca; U/Ca; Y/Ca (Distance)	Lewis et al. (2018), D'Olivo and McCulloch (2022)	Cantin and Lough (2014), De'ath et al. (2009)
LE18PAN01	PAN31B	−18.813	146.427	Pandora Reef	Ba^{138}/Ca; Ba/Ca; B/Ca; Cd/Ca; Li/Ca; Mg/Ca; Mn/Ca; Pb/Ca; P/Ca; Sr/Ca; U/Ca; Y/Ca (Distance)	Lewis et al. (2018), D'Olivo and McCulloch (2022)	Cantin and Lough (2014), De'ath et al. (2009)
LE18PAN02	PAN36B	−18.813	146.427	Pandora Reef	Ba^{138}/Ca; Ba/Ca; B/Ca; Cd/Ca; Li/Ca; Mg/Ca; Mn/Ca; Pb/Ca; P/Ca; Sr/Ca; U/Ca; Y/Ca (Distance)	Lewis et al. (2018), D'Olivo and McCulloch (2022)	Cantin and Lough (2014), De'ath et al. (2009)

Table A1. Continued.

Dataset ID	Core name	Latitude	Longitude	Location	Primary variables (secondary variables)	Record publication(s)	Additional core publication(s)
LE18PEL01	PEL30A	−18.538	146.49	Pelorus Island	Ba^{138}/Ca; Ba/Ca; B/Ca; Cd/Ca; Li/Ca; Mg/Ca; Mn/Ca; Pb/Ca; P/Ca; Sr/Ca; U/Ca; Y/Ca (Distance)	Lewis et al. (2018)	
LE18PEL02	PEL33B	−18.538	146.491	Pelorus Island	Ba^{138}/Ca; Ba/Ca; B/Ca; Cd/Ca; Li/Ca; Mg/Ca; Mn/Ca; Pb/Ca; P/Ca; Sr/Ca; U/Ca; Y/Ca (Distance)	Lewis et al. (2018)	
LE19HIG01	HI 12.1	−17.161	146.007	High Island	Ba/Ca; Ce; Dy; Er; Eu; Gd; Ho; La; Lu; Nd; Pr; Sm; Tb; Tm; Y; Yb; Zr	Leonard et al. (2019)	
LE19RUS01	FRI 12.1	−17.224	146.09	Russell Island	Ba/Ca; Ce; Dy; Er; Eu; Gd; Ho; La; Lu; Nd; Pr; Sm; Tb; Tm; Y; Yb; Zr	Leonard et al. (2019)	
LE19RUS02	FRI 12.3	−17.228	146.091	Russell Island	Ba/Ca; Ce; Dy; Er; Eu; Gd; Ho; La; Lu; Nd; Pr; Sm; Tb; Tm; Y; Yb; Zr	Leonard et al. (2019)	
LE19SUD01	SUD 12.1	−17.026	146.211	Sudbury Cay	Ba/Ca; Ce; Dy; Er; Eu; Gd; Ho; La; Lu; Nd; Pr; Sm; Tb; Tm; Y; Yb; Zr	Leonard et al. (2019)	
LO11ACH01	ACH01A	−18.95	146.65	Acheron Island	Luminescence Range	Lough (2011a, b)	Barnes and Lough (1992)
LO11BRO01	BRO01A	−18.15	146.28	Brook Island	Luminescence Range	Lough (2011a, b), D'Olivo and McCulloch (2022)	Barnes and Lough (1992), De'ath et al. (2009), Hendy et al. (2002, 2003a, b, 2007, 2012), Lough (2007), Lough and Barnes (1997)
LO11CID01	CID01A	−20.27	148.93	Cid Harbour Island	Luminescence Range	Lough (2011a, b)	De'ath et al. (2009), Lewis et al. (2012), Lough (2007), Lough and Barnes (1997)

Table A1. Continued.

Dataset ID	Core name	Latitude	Longitude	Location	Primary variables (secondary variables)	Record publication(s)	Additional core publication(s)
LO11CNR01	CNR01B	−15.13	145.32	Conical Rock Reef	Luminescence Range	Lough (2011a)	De'ath et al. (2009), Lough and Barnes (1997)
LO11COO01	COO01E	−18.03	146.18	Coombe Island	Luminescence Range	Lough (2011a, b)	Barnes and Lough (1992), De'ath et al. (2009), Lough (2007), Lough and Barnes (1997)
LO11DUN01	DUN02A	−17.95	146.17	Dunk Island	Luminescence Range	Lough (2011a, b)	
LO11GPI01	GPI02A	−18.68	146.58	Great Palm Island	Luminescence Range	Lough (2011a, b)	De'ath et al. (2009), Hendy et al. (2002, 2003a, b, 2007), Lough (2007), Lough and Barnes (1997)
LO11HAV01	HAV01A	−18.85	146.55	Havannah Island	Luminescence Range	Lough (2011a, b), Palmer et al. (2015)	D'Olivo and McCulloch (2022), De'ath et al. (2009), Erler et al. (2020), Hendy et al. (2002, 2003a, b, 2007, 2012), Isdale et al. (1998), Lough (2007), Lough and Barnes (1997), Lough et al. (2015), McCulloch et al. (2003)
LO11HKO01	HKO01B	−20.07	148.95	Hook Island	Luminescence Range	Lough (2011a, b)	Barnes and Lough (1992), De'ath et al. (2009), Lough (2007), Lough and Barnes (1997)
LO11HKO02	SNH01A	−20.1	148.9	Stonehaven Bay, Hook Island	Luminescence Range	Lough (2011a, b)	De'ath et al. (2009), Lough and Barnes (1997)
LO11HMP01	HMP01B	−23.2	151	Humpy Island	Luminescence Range	Lough (2011a, b), D'Olivo and McCulloch (2022)	Lough (2007);
LO11LUP01	LUP01C	−20.28	149.12	Lupton Island	Luminescence Range	Lough (2011a, b)	Barnes and Lough (1992), De'ath et al. (2009), Lough (2007), Lough and Barnes (1997)

Table A1. Continued.

Dataset ID	Core name	Latitude	Longitude	Location	Primary variables (secondary variables)	Record publication(s)	Additional core publication(s)
LO11MAG01	MAG01D	−19.15	146.87	Geoffrey Bay, Magnetic Island	Luminescence Range	Lough (2011a, b), D'Olivo and McCulloch (2022)	Barnes and Lough (1992), De'ath et al. (2009), Erler et al. (2016), Lewis (2005), Lewis et al. (2007), Lough (2007), Lough and Barnes (1997)
LO11NMI01	NMI01B	−20.23	148.8	North Molle Island	Luminescence Range	Lough (2011a, b)	Barnes and Lough (1992), De'ath et al. (2009), Lough (2007), Lough and Barnes (1997)
LO11NOR01	NOR01B	−17.2	146.1	Normanby Island	Luminescence Range	Lough (2011a, b), D'Olivo and McCulloch (2022)	Barnes and Lough (1992), De'ath et al. (2009), Lough (2007)
LO11PAN01	PAN07B	−18.82	146.43	Pandora Reef	Luminescence Range	Lough (2011a)	Barnes and Lough (1992), De'ath et al. (2009), Lough (2007)
LO11SMI01	SMI01C	−20.27	148.83	South Molle Island	Luminescence Range	Lough (2011a, b)	Barnes and Lough (1992), De'ath et al. (2009), Lough (2007), Lough and Barnes (1997)
LO14NEL01	NEL03A	−19	147	Nelly Bay, Magnetic Island	Luminescence Range	Lough et al. (2014)	
LO14NEL02	NEL03D	−19	147	Nelly Bay, Magnetic Island	Luminescence Range	Lough et al. (2014)	Lewis (2005)
LO14NEL03	NEL07B	−19	147	Nelly Bay, Magnetic Island	Luminescence Range	Lough et al. (2014)	
LO14NEL04	NEL07C	−19	147	Nelly Bay, Magnetic Island	Luminescence Range	Lough et al. (2014)	
LO14NEL05	NEL01D	−19	147	Nelly Bay, Magnetic Island	Luminescence Range	Lough et al. (2014)	Lewis (2005), Lewis et al. (2007)
LO14NEL06	NEL29A	−19.1646	146.8658	Nelly Bay, Magnetic Island	Luminescence Range	Lough et al. (2014)	Cantin and Lough (2014), De'ath et al. (2009), Lewis et al. (2018)
LO14NEL07	NEL35A	−19.164	146.854	Nelly Bay, Magnetic Island	Luminescence Range	Lough et al. (2014)	Cantin and Lough (2014), De'ath et al. (2009)

Table A1. Continued.

Dataset ID	Core name	Latitude	Longitude	Location	Primary variables (secondary variables)	Record publication(s)	Additional core publication(s)
LO14NEL08	NEL39B	−19.169	146.8502	Nelly Bay, Magnetic Island	Luminescence Range	Lough et al. (2014)	Cantin and Lough (2014), De'ath et al. (2009)
LO15HAV01	HAV01A	−18.85	146.55	Havannah Island	Luminescence Range	Lough et al. (2015)	D'Olivo and McCulloch (2022), De'ath et al. (2009), Erler et al. (2020), Hendy et al. (2002, 2003a, b, 2007, 2012), Isdale et al. (1998), Lough (2007, 2011a, b), Lough and Barnes (1997), McCulloch et al. (2003), Palmer et al. (2015)
LO15HAV02	HAV31B	−18.837	146.5483	Havannah Island	Luminescence Range	Lough et al. (2015)	
LO15HAV03	HAV32A	−18.8351	146.544	Havannah Island	Luminescence Range	Lough et al. (2015)	Lewis et al. (2018)
LO15HAV04	HAV33A	−18.837	146.5483	Havannah Island	Luminescence Range	Lough et al. (2015)	
LO15HAV05	HAV34A	−18.837	146.5483	Havannah Island	Luminescence Range	Lough et al. (2015)	Lewis et al. (2018)
MA00MYR01	Myr-2	−18.266	147.383	Myrmidon Reef	Sr/Ca (Distance)	Marshall (2000), Marshall and McCulloch (2002)	Fallon (2000), Fallon et al. (2003)
MA00MYR02	Myr2-16D	−18.266	147.383	Myrmidon Reef	$\delta^{13}C$; $\delta^{18}O$ (Distance)	Marshall (2000)	
MA00MYR03	Myr2-17D	−18.266	147.383	Myrmidon Reef	Ba/Ca; Mg/Ca; Sr/Ca; U/Ca (Distance)	Marshall (2000)	
MA00SLY01	St-1	−19.2892	148.0519	Stanley Reef	Sr/Ca (Distance)	Marshall (2000), Marshall and McCulloch (2002)	
MC03HAV01	Havannah	−18.843	146.537	Havannah Island	Ba/Ca	McCulloch et al. (2003), Lewis et al. (2007), Walther et al. (2013)	
MC03PAN01	Pandora	−18.8	146.4	Pandora Reef	Ba/Ca	McCulloch et al. (2003), D'Olivo and McCulloch (2022)	

Table A1. Continued.

Dataset ID	Core name	Latitude	Longitude	Location	Primary variables (secondary variables)	Record publication(s)	Additional core publication(s)
MC17DAV01	Davies 13-2 (D-2)	−18.8	147.63	Davies Reef	Ba/Ca; B/Ca; B/Mg; δ^{11}B; Li/Ca; Li/Mg; Mg/Ca; Sr/Ca; U/B; U/Ca; U/Sr (δ^{11}B pH_{cf})	McCulloch et al. (2017), Thompson et al. (2022)	D'Olivo et al. (2018)
MC17DAV02	Davies 13-3 (D-3)	−18.8	147.63	Davies Reef	Ba/Ca; B/Ca; B/Mg; δ^{11}B; Li/Ca; Li/Mg; Mg/Ca; Sr/Ca; U/B; U/Ca; U/Sr (δ^{11}B pH_{cf})	McCulloch et al. (2017), Thompson et al. (2022)	D'Olivo et al. (2018)
PE05FLI01	FL02A (FLI02A)	−17.73	148.43	Flinders Reef	δ^{11}B; δ^{13}C (Ωarag; Calcification; Extension; δ^{11}B pH)	Pelejero et al. (2005)	Calvo et al. (2007)
RA17MYR01	myra-30	−18.278	147.379	Myrmidon Reef	Ba/Ca; Mg/Ca; Sr/Ca; U/Ca; Y/Ca	Razak et al. (2017)	
RA17MYR02	myra-31	−18.278	147.379	Myrmidon Reef	Ba/Ca; Mg/Ca; Sr/Ca; U/Ca; Y/Ca	Razak et al. (2017)	
RE19CLK01	CLK (CLK06A)	−11.97	143.28	Clerke Reef	Luminescence; Sr/Ca (Density; Distance)	Reed et al. (2019)	
RE19EEL01	EEL (EELB10)	−12.5	143.52	Eel Reef	δ^{13}C; δ^{18}O; Luminescence; Sr/Ca (Density; Distance)	Reed et al. (2019)	Barnes and Lough (1992), Lough and Barnes (2000), Lough et al. (2002)
RE19GBR01	13-050 (050B06)	−13.33	143.95	Reef 13-050	δ^{13}C; δ^{18}O; Luminescence; Sr/Ca (Density; Distance)	Reed et al. (2019)	Barnes and Lough (1992), Lough and Barnes (1992), De'ath et al. (2009); Lough et al. (2002), Madin et al. (2016)
RE19NOM01	NOM (NOM05A)	−12.09	143.29	Nomad Reef	Luminescence; Sr/Ca (Density; Distance)	Reed et al. (2019)	
RE19POR01	POR (PORB03)	−12.591	143.408	Portland Roads	δ^{13}C; δ^{18}O; Luminescence; Sr/Ca (Density; Distance)	Reed et al. (2019)	Barnes and Lough (1992), Lough and Barnes (1992), De'ath et al. (2009); Lough et al. (2002), Madin et al. (2016)

Table A1. Continued.

Dataset ID	Core name	Latitude	Longitude	Location	Primary variables (secondary variables)	Record publication(s)	Additional core publication(s)
RO14GKI01	GK2	−23.1505	150.9739	Great Keppel Island	Luminescence G/B	Rodriguez-Ramirez et al. (2014), Grove et al. (2015)	Saha et al. (2018a, 2019a, 2021)
RO14GKI02	GK3	−23.192	150.9627	Great Keppel Island	Luminescence G/B	Rodriguez-Ramirez et al. (2014)	
RO14KIN01	KR-MMA-1	−17.767	146.133	King Reef	$\delta^{18}O$; Sr/Ca ($\delta^{18}O_{seawater}$)	Roche et al. (2014)	
RO14KIN02	KR-AMA-2	−17.767	146.133	King Reef	$\delta^{18}O$; Sr/Ca ($\delta^{18}O_{seawater}$)	Roche et al. (2014)	
RO14MIA01	MI1	−23.155	150.9035	Miall Island	Luminescence G/B	Rodriguez-Ramirez et al. (2014), Grove et al. (2015)	
RO14MIA02	MI2	−23.1554	150.9034	Miall Island	Luminescence G/B	Rodriguez-Ramirez et al. (2014)	
RO14SQR01	SQ1	−23.0997	150.8862	Square Rocks	Luminescence G/B	Rodriguez-Ramirez et al. (2014), Grove et al. (2015)	
RO14SQR02	SQ2	−23.0997	150.8862	Square Rocks	Luminescence G/B	Rodriguez-Ramirez et al. (2014), Grove et al. (2015)	
SA16HER01a	AR HL 3	−23.451	151.93	Heron Island	Sr/Ca	Sadler et al. (2016a)	
SA16HER01b	P HS 1	−23.451	151.93	Heron Island	Sr/Ca	Sadler et al. (2016b)	
SA16HER02a	AR HL 4	−23.451	151.93	Heron Island	Sr/Ca	Sadler et al. (2016a)	
SA16HER02b	P HS 3	−23.451	151.93	Heron Island	Sr/Ca	Sadler et al. (2016b)	
SA16HER03a	AR HL 6	−23.451	151.93	Heron Island	Sr/Ca	Sadler et al. (2016a)	
SA16HER03b	P HS 4	−23.451	151.93	Heron Island	Sr/Ca	Sadler et al. (2016b)	
SA16HER04a	AR HS 3	−23.451	151.93	Heron Island	Sr/Ca	Sadler et al. (2016a)	
SA16HER04b	P HS 7	−23.451	151.93	Heron Island	Sr/Ca	Sadler et al. (2016b)	
SA16HER05a	AR HS 5	−23.451	151.93	Heron Island	Sr/Ca	Sadler et al. (2016a)	
SA16HER05b	R9C (track 1)	−23.451	151.93	Heron Island	Sr/Ca	Sadler et al. (2016b)	
SA16HER06a	AR HS 6	−23.451	151.93	Heron Island	Sr/Ca	Sadler et al. (2016a)	
SA16HER06b	R15B3	−23.451	151.93	Heron Island	Sr/Ca	Sadler et al. (2016b)	

Table A1. Continued.

Dataset ID	Core name	Latitude	Longitude	Location	Primary variables (secondary variables)	Record publication(s)	Additional core publication(s)
SA21GFB01	GFB33B	−19.1543	146.8656	Geoffrey Bay, Magnetic Island	Ba/Ca; Ce; Dy; Eu; Gd; Ho; La; Lu; Mn/Ca; Nd; Nd/Yb; Pr; Sm; Sr/Ca; Tb; Tm; Y; Yb; Y/Ca (Ce/Ce*; ΣREE/Ca)	Saha et al. (2021, 2019b)	Lewis et al. (2018)
SA21GKI01	GK2	−23.17	150.98	Great Keppel Island	Ba/Ca; Ce; Dy; Eu; Gd; Ho; La; Lu; Mg/Ca; Mn/Ca; Nd; Pr; Sm; Sr/Ca; Tb; Tm; U/Ca; V/Ca; Y; Yb; Y/Ca	Saha et al. (2021, 2018a, 2019a)	Rodriguez-Ramirez et al. (2014)
SA21RAT01	RI2	−23.7663	151.3178	Rat Island	Ba/Ca; Ce; Dy; Eu; Gd; Ho; La; Lu; Mn/Ca; Nd; Pr; Sm; Sr/Ca; Tb; Tm; Y; Yb; Y/Ca	Saha et al. (2021, 2018b)	
WA13HAV01	Havannah (Hav08_2)	−18.8396	146.5502	Havannah Island	Ba/Ca	Walther et al. (2013), D'Olivo and McCulloch (2022)	
WA13MYR01	Myrmidon (MYR_S5)	−18.2614	147.3765	Myrmidon Reef	Ba/Ca	Walther et al. (2013)	
WA19ARL01	10AR2	−16.6381	146.1036	Arlington Reef	δ^{98}Mo; Fe; Mn; Ti	Wang et al. (2019), Deng et al. (2014)	Chen et al. (2021), Xiao et al. (2020)
WE09ARL01_1	AREO 4	−16.667	146.109	Arlington Reef	Ba/Ca; δ^{11}B; δ^{13}C; δ^{18}O; Mg/Ca; Sr/Ca (δ^{11}B pH)	Wei et al. (2009), D'Olivo and McCulloch (2017), Chen et al. (2021)	Wei et al. (2015)
WE09ARL01_2	AREO 4	−16.674	146.109	Arlington Reef	Ba/Ca; δ^{11}B; δ^{13}C; δ^{18}O; Mg/Ca; Sr/Ca (δ^{11}B pH)	Wei et al. (2009, D'Olivo and McCulloch (2017), Chen et al. (2021)	Wei et al. (2015)
WU21CUR01	SEN01C	−23.7547	151.3169	South End, Curtis Island	B/Ca; Li/Ca; Mg/Ca; Sr/Ca; U/Ca	Wu et al. (2021b)	Cantin et al. (2018)
WU21HUM01	HUM03A	−23.4035	151.1472	Hummocky Island	B/Ca; Li/Ca; Mg/Ca; Sr/Ca; U/Ca	Wu et al. (2021b)	Cantin et al. (2018)
WU21HUM02	HUM04B	−23.4024	151.146	Hummocky Island	B/Ca; Li/Ca; Mg/Ca; Sr/Ca; U/Ca	Wu et al. (2021b)	
WU21MAS01a	MAS02A	−23.532	151.7403	Mast Head Island	B/Ca; Li/Ca; Mg/Ca; Sr/Ca; U/Ca	Wu et al. (2021b)	Cantin et al. (2018)

Table A1. Continued.

Dataset ID	Core name	Latitude	Longitude	Location	Primary variables (secondary variables)	Record publication(s)	Additional core publication(s)
WU21MAS01b	MAS01E	−23.5325	151.746	Mast Head Island	Δ14C	Wu et al. (2021a), Cantin et al. (2018)	
WU21SHW01	SHW82C	−20.4796	149.0691	Shaw Island	B/Ca; Li/Ca; Mg/Ca; Sr/Ca; U/Ca	Wu et al. (2021b)	
WU21SMI01	SMI81A	−20.2588	148.8283	South Molle Island	B/Ca; Li/Ca; Mg/Ca; Sr/Ca; U/Ca	Wu et al. (2021b)	
XI20ARL01	10AR2	−16.6381	146.1036	Arlington Reef	$\delta^{13}C$; $\delta^{18}O$; $\delta^{66}Zn$; Sr/Ca; Zn	Xiao et al. (2020);	Chen et al. (2021), Deng et al. (2014), Wang et al. (2019)

Note the additional publications referenced in the GBRCD:
– Chakraborty and Ramesh (1993, 1997) for CH93SLY01 and CH93SLY02;
– Davies and Hopley (1983) for MA00MYR02 and MA00MYR03;
– Kamber et al. (2005) for JU08KES01b and JU08RTI01b;
– Min et al. (1995) for HE02GBR01, LE07MAG01, and LE07NEL01.

Appendix B: GBRCD to LiPD field translation

Table B1. GBRCD to LiPD time series (TS) field translation dictionary.

GBRCD field	LiPD field	Notes
Age	year	LiPD standard age unit is yr AD so this description is used for the LiPD version rather than yr CE which is used for the CSV version. yr CE and yr AD are identical values.
cdata_datasetID	dataSetName	
cdata_coreName	paleoData_core	
cdata_altCoreName	NA	Joined with cdata_coreName, separated by ";".
cdata_IGSN	hasIGSN	
cdata_collectTime	collectionYear	
cdata_minYear	minYear	Values for LiPD extracted from GBRCD record "Age" field.
cdata_maxYear	maxYear	
cdata_archiveSpecies	paleoData_sensorSpecies	
cdata_isDatabaseDuplicate	paleoData_gbrIsDatabaseDuplicate	
cdata_dataCoverageGroup	paleoData_gbrDataCoverageGroup	
cdata_coralNotes	notes	
geo_latitude	geo_latitude	
geo_longitude	geo_longitude	
geo_siteName	geo_siteName	
geo_siteName2	geo_location	
geo_elevation	geo_elevation	
geo_elevationNotes	geo_notes	
dating_UThDate	paleoData_gbrUThDate	
Dating_UThDateError	paleoData_gbrUThDateUncertainty	
dating_14CDate	paleoData_gbr14CDate	
Dating_14CDateError	paleoData_gbr14CDateUncertainty	
dating_notes	paleoData_gbrDatingNotes	
meths_primaryVariablesList	NA TS13	List of variables intrinsic to LiPD and therefore unnecessary to translate as a separate field in LiPD format.
meths_additionalVariablesList	NA	

Table B1. Continued.

GBRCD field	LiPD field	Notes
meths_TEMethod	paleoData_measurementMethod	GBRCD CSV fields are split by measurement type whereas for the LiPD TS a single field name is used, and the information is grouped with the variable. Where multiple methods and/or instruments have been used for one proxy both are available in the relevant field separated by ";".
meths_TEMethodMachine	paleoData_measurementInstrument	
meths_isotopeMethod	paleoData_measurementMethod	
meths_isotopeMethodMachine	paleoData_measurementInstrument	
meths_luminMethod	paleoData_measurementMethod	
meths_luminMethodMachine	paleoData_measurementInstrument	
meths_altMethodInfo	paleoData_measurementMethod	
meths_methodNotes	paleoData_notes	
meths_hasResolutionNominal	paleoData_samplingResolution	
meths_resolutionMin	NA	Values intrinsic to LiPD format.
meths_resolutionMax	NA	
meths_resolutionMean	NA	
meths_resolutionMedian	NA	
meths_isAnomaly	paleoData_gbrIsAnomaly	
meths_chronologyNotes	paleoData_gbrChronologyNotes	
meths_coralExtensionRate	paleoData_coralExtensionRate	
meths_coralExtensionRateNotes	paleoData_coralExtensionRateNotes	
meths_tissueThickness	paleoData_coralTissueThickness	
meths_jcpMeasured	paleoData_jcpUsed	
meths_jcpSrCaValue	paleoData_jcpMeasured	
meths_SrCaAnalyticalPrecision	paleoData_uncertaintyAnalytical	GBRCD CSV fields are split by variables whereas for the LiPD TS a single field name is used (for the uncertainty and for the uncertainty units) and the information is grouped with the variable.
meths_SrCaAnalyticalPrecisionUnits	paleoData_uncertaintyAnalyticalUnits	
meths_UCaAnalyticalPrecision	paleoData_uncertaintyAnalytical	
meths_UCaAnalyticalPrecisionUnits	paleoData_uncertaintyAnalyticalUnits	
meths_d18OAnalyticalPrecision	paleoData_uncertaintyAnalytical	
meths_d18OAnalyticalPrecisionUnits	paleoData_uncertaintyAnalyticalUnits	
meths_altPrecisionList	NA	
meths_altAnalyticalPrecision	paleoData_analyticalUncertainty	
meths_altAnalyticalPrecisionUnits	paleoData_uncertaintyAnalyticalUnits	
meths_archiveDiagenesisCheck	paleoData_measurementMaterialScreening	
calib_isSSTCalibration	gbrIsSstCalibration	
calib_useSSTCalibration	gbrUseSstCalibration	
calib_hasAlternateCalibration	gbrHasAlternateCalibration	
calib_notes	calibration_notes	
calib_isComposite	gbrIsCompositeCalibration	
calib_compositeList	gbrCompositeCalibrationList	
calib_SSTdata	calibration_targetDataset	

Table B1. Continued.

GBRCD field	LiPD field	Notes
calib_fitPeriod	calibration_datasetRange	
calib_hasCentredEquation	NA	The GBRCD field is a flag for information occurring in calib_ centredEquationNotes and is not used in the LiPD format.
calib_centredEquationNotes	calibration_gbrCentredEquationNotes	
calib_method	calibration_method	
calib1_equationIntercept	calibration_equationIntercept	GBRCD CSV fields are split by measurement type whereas for the LiPD TS a single field name is used (for the intercept, slope, slope uncertainty and r^2) and the information is grouped with the variable.
calib1_equationSlope	calibration_equationSlope	
calib1_equationSlopeUncertainty	calibration_equationSlopeUncertainty	
calib1_equationR2	calibration_equationR2	
calib2_equationIntercept	calibration_equationIntercept	
calib2_equationSlope	calibration_equationSlope	
calib2_equationSlopeUncertainty	calibration_equationSlopeUncertainty	
calib2_equationR2	calibration_equationR2	
calib3_equationIntercept	calibration_equationIntercept	
calib3_equationSlope	calibration_equationSlope	
calib3_equationSlopeUncertainty	calibration_equationSlopeUncertainty	
calib3_equationR2	calibration_equationR2	
pub1_firstauthor	pub1_firstAuthor	
pub1_year	pub1_year	
pub1_doi	pub1_doi	
pub1_citation	pub1_citation	
pub1_authors	pub1_author	
pub1_title	pub1_title	
pub1_journal	pub1_journal	
pub1_doiData	pub1_doiData	
pub1_altDataURL	pub1_altDataURL	
pub2_firstauthor	pub2_firstAuthor	
pub2_year	pub2_year	
pub2_doi	pub2_doi	
pub2_citation	pub2_citation	
pub2_authors	pub2_author	
pub2_title	pub2_title	
pub2_journal	pub2_journal	

Table B1. Continued.

GBRCD field	LiPD field	Notes
pub2_altDataURL	pub2_altDataURL	
pub3_firstauthor	pub3_firstAuthor	
pub3_year	pub3_year	
pub3_doi	pub3_doi	
pub3_citation	pub3_citation	
pub3_authors	pub3_author	
pub3_title	pub3_title	
pub3_journal	pub3_journal	
pub3_altDataUrl	pub3_altDataUrl	
pub_isCoreIDOtherStudy	gbrIsCoreIDOtherStudy	
pub_coreIDOtherStudyList	gbrCoreIDOtherStudyList	

Appendix C: GBRCD additional coral information

Several of the coral records were measured in specific contexts, had additional processing to recreate the original published age model in the GBR database, or are published in the GBR database for the first time. This contextual and methodological information is summarised here and is included in the relevant note field(s) in the GBR database metadata table.

C1 Split datasets

In the GBRCD, four corals and their related records from three publications were given split IDs due to differences in the data, such as resolution and/or age model. The Alibert et al. (2003) (Davies-2; GBRCD ID: AL03DAV01_1 and AL03DAV01_2. PAN 98-2; AL03PAN01_1 from AL03PAN01_2, AL03PAN01_3, and AL03PAN01_4), Druffel and Griffin (1999) (Abraham-1; DR99ABR01_1 and DR99ABR01_2) and Wei et al. (2009) Arlington Reef (AREO 4; WE09ARL01_1 and WE09ARL01_2) coral records were split due to differences in the resolution of the data. AREO4 (WE09ARL01_1 and WE09ARL01_2) was split where the resolution changed from quinquennial (1800–1939) to annual (1940–2004) for all measured variables. The Abraham-1 (DR99ABR01_1 and DR99ABR01_2) coral record was previously archived separately (δ^{13}C and δ^{18}O is approximately annual, and the Δ^{14}C is approximately biennial), and this was maintained in the database. Davies-2 (AL03DAV01_1 and AL03DAV01_2) and PAN 98-2 (AL03PAN01_1 from AL03PAN01_2, AL03PAN01_3 and AL03PAN01_4) records were split due to differences in resolutions arising from two methods of measuring trace elements (thermal ionisation mass spectrometer (TIMS) vs. laser ablation inductively coupled plasma mass spectrometer (LA-ICP-MS)). Additionally, the LA-ICP-MS measurements from Alibert et al. (2003) were not combined into a single record as there were three distinct age models for the data, and each of these was presented in the original publication.

C2 Additions, modifications, and PhD theses

The GBRCD includes 15 records from five publications where the age model was created for archiving in the GBRCD. As described in the main paper, a base level of information was required to archive each record in the GBRCD; notably, each dataset should have an age model with an age assigned to each data point. A brief description of the method(s) used to create the age model for these records, as well any change(s) in the record compared to the previously published version, is described below. Additionally, as PhD theses can be more difficult to access than published journal articles, a brief description of relevant information is supplied for six records from three PhD theses.

C2.1 Chakraborty (1993) – PhD thesis

SR coral records (track 1 and track 2) (CH93SLY01 and CH93SLY02) were collected from Stanley Reef in December 1986 (Chakraborty et al., 2000). The coral was prepared and analysed for stable isotopes along two tracks: track 1 close to the central growth axis and track 2 $\sim 20°$ off the axis, as described in Chakraborty et al. (2000). Methods were as described in Chakraborty and Ramesh (1993, 1997). The original coral age model was based on Comprehensive Ocean-Atmosphere Data Set (COADS) SST data; however, since COADS is missing months of data for the Stanley Reef region, the HadISST1.1 data (grid centred on 19.5° S, 148.5° E; Rayner et al., 2003) were used for archiving in the GBRCD. A new age model was created to obtain ages based on linear interpolation using QAnalySeries to align δ^{18}O minima (maxima) with SST maxima (minima) for quarterly averaged HadISST data. The age model was based on available information; however, the records published in Chakraborty et al. (2000) have additional δ^{18}O measurements not available to be archived in the GBRCD. There was no change in the SR track 1 age model, but for SR track 2, ~ 2 years of data (summer 1978 to winter 1980) do not have sufficient data points to pair with the SST data, so these years were not included in the database.

C2.2 Ellis et al. (2019)

PET12 (EL19OTI01; Ellis et al., 2019) was harvested by J. Mallela in May 2012 from Pete's Bay in the One Tree Island lagoon. The original PET12 chronology published in Ellis et al. (2019) was based on Sr/Ca maxima and minima and was applied to three pieces of PET-12 (PET12-1, 2 and 3) after data smoothing with a 10-point running mean and then interpolated to a monthly time series. LA-ICP-MS data from an additional piece of PET-12 (PET-12-4) was combined with the data from the other pieces (PET12-1, 2 and 3) (Fig. C1). To align the entire PET12 LA-ICP-MS dataset with the standard procedure used by other LA-ICP-MS datasets in the GBRCD, the original data smoothed with a 10-point running mean were further reduced with a 10-point mean. A new chronology was then assigned to the dataset using QAnalySeries to tie Sr/Ca maxima (minima) with SST minima (maxima) using a weekly averaged NOAA Reyn_SmithOIv2 weekly SST dataset (Reynolds et al., 2002) centred on 23.5° S, 152.5° E. Scanning electron microscopy (SEM) analysis of an alternate slice of the PET12 coral by A. TS15 Arzey indicated variable and patchy diagenetic alteration with evidence of micro-borers and secondary aragonite crystals generally 0–10 µm in length but up to 20 µm in length observed in some sections (Fig. C2).

C2.3 Fallon (2000) – PhD thesis

Pan 1-98b (FA00PAN01) is a *Porites* sp. coral collected from Pandora Reef in October 1998, and it is an additional core

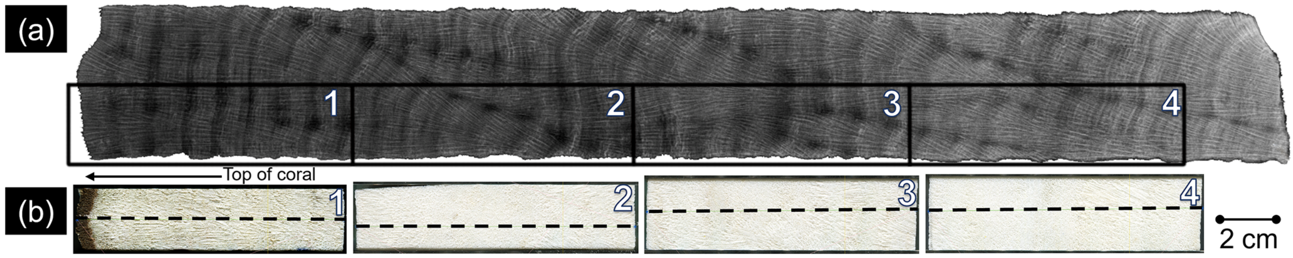

Figure C1. PET12 (EL19OTI01) **(a)** X-radiograph (negative) of PET12 (EL19OTI01) coral. Black boxes indicate the four pieces analysed, and they are labelled with the piece number (1–4 in the top of the box). **(b)** Photos of PET12 pieces 1–4, and dashed black lines indicate the track analysed by LA-ICP-MS for each section of the record included in EL19OTI01. X-radiograph and photos supplied by J. TS14 Mallela.

from the same coral as Pan 1-98a (related record published in Fallon et al. (2003); FA03PAN01). Pan 1-98b was dead on top when collected and likely stopped recording environmental information in March/April 1998, as described in Fallon (2000). A 46 mm section from Pan 1-98b covering the period 1996–1998 was analysed by LA-ICP-MS as described in Fallon et al. (2003); the method used an ArF excimer laser (193 nm) that was masked to illuminate a 50 µm × 500 µm rectangle on the coral surface and a laser pulsed at 5 Hz using a 50 mJ power setting.

C2.4 Jupiter (2008)

KIA (JU08KES01b) and RTF (JU08RTI01b) are *Porites* spp. coral cores collected in 2004 from Keswick Island and Round Top Island, respectively, and were previously described in Jupiter (2006) (PhD thesis). Both corals' annual growth bands were bulk sampled, and 3–5 consecutive years per decade were analysed for rare earth elements and yttrium (REYs) for the period 1950–2002. Samples were analysed using a Thermo X-Series inductively coupled plasma mass spectrometer (ICP-MS) at the University of Queensland.

C2.5 Lewis (2005) – PhD thesis

MAG01D (LE05MAG01) is a modern *Porites* sp. coral collected from Geoffrey Bay, Magnetic Island, by the Australian Institute of Marine Science (AIMS) in 1987, while NEL01D (LE05NEL01) and NEL03D (LE05NEL02) are fossil *Porites* spp. corals collected from Nelly Bay Harbour, Magnetic Island, in 2001, and they were previously described in Lewis (2005). Top and bottom growth bands for NEL01D and NEL03D were U-Th dated at the ACQUIRE laboratory at the University of Queensland. Fragments (2 cm × 2 cm samples) of the bottom and top of MAG01D, NEL01D, and NEL03D were platinum-coated and examined for diagenesis using scanning electron microscopy, and additional thin sections were also examined with a Leica IM50 microscope. Analysis for diagenetic alteration of the corals noted no distinct differences between the modern and fossil corals. The corals were sampled by homogenising 5-yearly increments and were split into two batches. One batch was pre-treated with H_2O_2 and was analysed for Ba/Ca, Mg/Ca, Sr/Ca, and Mn at the Queensland Health Scientific Services (QHSS) laboratory. The other batch was not pre-treated and was analysed for $\delta^{13}C$ and $\delta^{18}O$ with a Micromass Prism III stable isotope mass spectrometer at the University of Wollongong.

C2.6 Marshall (2000) – PhD thesis

Myr-2 (MA00MYR01) is a *Porites* sp. coral collected from Myrmidon Reef in July 1996 (Marshall and McCulloch, 2002). As the data were archived in the PhD thesis appendix without an age model, a new coral age model was created for archiving in the GBRCD. The new coral age model was based on published information from Marshall and McCulloch (2002) and Marshall (2000). The original data chronology and calibration was based on the Australian Institute of Marine Science (AIMS) weekly instrumental Myrmidon Reef SST data. However, the AIMS Myrmidon loggers' SST data only covered the period from 1988 to 1996, whereas the Myr-2 Sr/Ca record extends back to 1973 and is at approximately monthly resolution (< 20 measurements per year). A new chronology was assigned to the data using QAnalySeries to align Sr/Ca minima (maxima) with SST maxima (minima) for HadISST grid square centred on 18.5° S, 147.5° E.

Myr2-16D (MA00MYR02) and Myr2-17D (MA00MYR03) are *Porites* sp. coral collected from the Myrmidon Hole 2 drill core matrix (Davies and Hopley, 1983; Marshall, 2000). Myr2-16D was analysed by Marshall (2000) for $\delta^{13}C$ and $\delta^{18}O$ at The Australian National University using a Finnigan MAT 251 mass spectrometer coupled with a Kiel device to assess the fluorescent banding in the coral and its potential link with precipitation/river flow. The $\delta^{18}O$ data presented in Marshall (2000) have a correction of 0.011 ‰ per metre applied for ice volume that assumed sea level was 15–20 m below present-day sea level. The correction is not applied to the $\delta^{18}O$ data archived in the GBRCD. Myr2-17D was analysed for B, Mg, Ca, Sr, Ba, and U by LA-ICP-MS using a 193 nm ArF excimer laser connected to a VG Elemental PlasmaQuad PQ2+ instrument with a 50 µm × 500 µm slit as described in Marshall (2000).

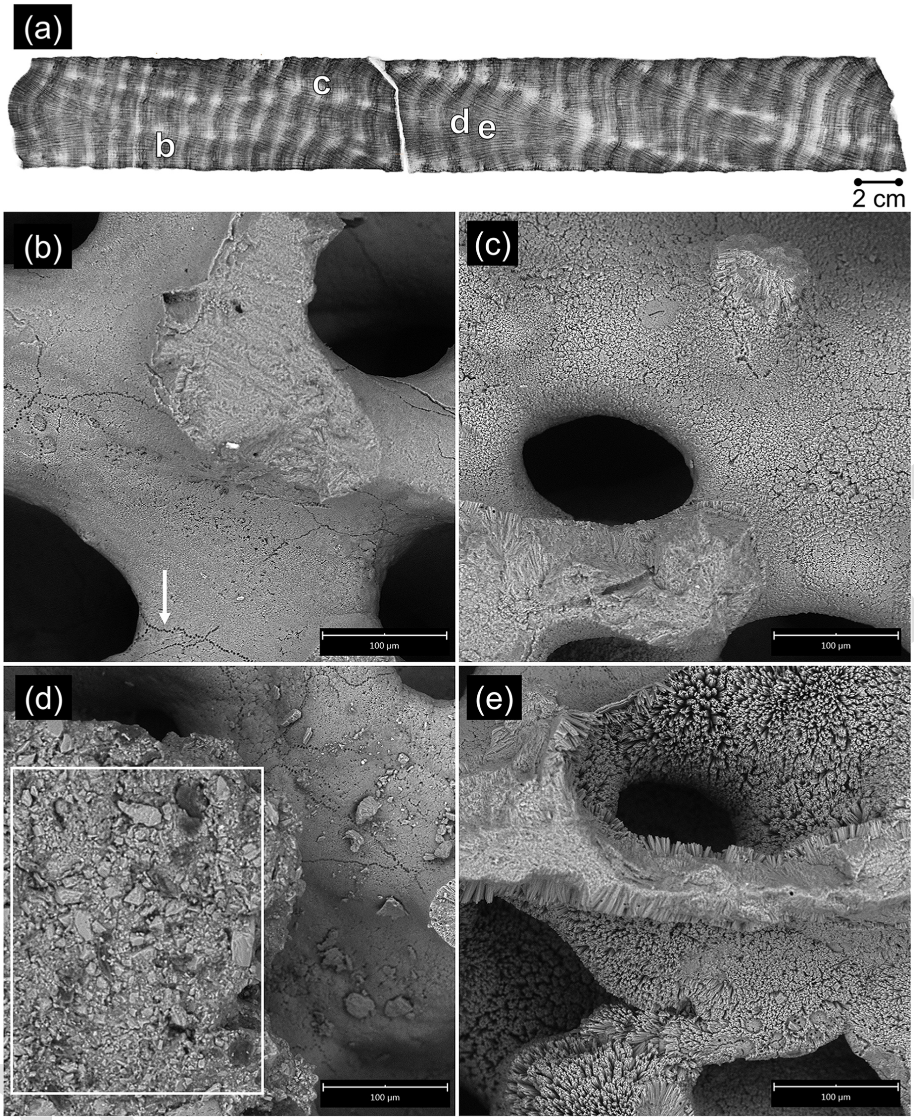

Figure C2. PET12 (EL18OTI01) SEM images from alternate slice of PET12 coral. **(a)** Approximate locations of SEM images labelled **(b)**–**(e)** on coral X-radiograph. X-radiograph by PRP Diagnostic Imaging Wollongong. **(b)** to **(e)** Select SEM images from PET12 (EL19OTI01); **(b)** No secondary aragonite. Evidence of micro-borers (example noted by white arrow), **(c)** Low-level diagenetic alteration with nearly 100 % cover of secondary aragonite needles $\leq 5\,\mu$m and evidence of micro-borers, **(d)** Bioclastic cement plug (marked by white box) above relatively pristine coral surface with cement chips and evidence of micro-borers, **(e)** 90 % cover of secondary aragonite needles of 5–20 µm. Scale bar indicates 100 µm **(b–e)**.

TIMS U-series dates were available for both coral pieces; however, the data for both corals did not include an age model. An age model for Myr-2-16D and Myr2-17D was created for archiving using QAnalySeries to match δ^{18}O or Sr/Ca maxima with generalised monthly SST minima (minimum SST occurring in July).

The Myr2-17D U-Th calibrated age published in Marshall (2000) was 7880 ± 60 years (ago). However, no date for the U-series analysis is supplied. Thus, to determine the age relative to the Common Era for archiving, it is assumed that it was dated in the same year as publication (i.e. 2000), thus transforming the Myr2-17D age to -5881 ± 60 CE (i.e. 5881 ± 60 BCE).

Myr2-16D was in three parts, and each section was previously U-Th dated separately, giving a calibrated age range from 7646 ± 60 years (ago) for the basal section to 7968 ± 100 years (ago) for the top section (with a middle section dated as 7846 ± 30 years (ago)) (Marshall, 2000). Density band counting of an alternate slice suggests a maximum of 20 years between the top and bottom of the coral piece. The U-series dates are not within error and/or suggest an age reversal in the Myrmidon Hole 2 drill core when considering the date of the top (youngest) section of Myr2-16D is older than Myr2-17D. In 2022, a piece of the middle section (∼ 5–6 cm from the top of Myr2-16D) of the alternate slice was U-Th dated and used as the age of Myr2-16D for the GBRCD. The 2022 U-series date was measured at the Radiogenic Isotope Facility, University of Queensland, and gave a calibrated age of −5755 ± 13 CE (i.e. 5755 ± 13 BCE; Table D1).

St-1 is a *Porites* sp. coral collected from Stanley Reef in January 1999 (Marshall, 2000; Marshall and McCulloch, 2002). The age model was created based on published information from Marshall and McCulloch (2002) and Marshall (2000). A chronology was assigned to the data for archiving in the GBRCD using QAnalySeries to align Sr/Ca minima (maxima) with SST maxima (minima) for fortnightly averaged AIMS in situ logger data from Davies Reef and Hardy Reef. The original publications only used the Davies Reef SST data, which due to missing data can only create an age model for the period of August 1996 to January 1999. The AIMS Hardy Reef SST data closely resembles the Davies Reef SST data, and both are approximately equidistant from Stanley Reef, making them a suitable dataset to estimate the regional SST seasonality. Using both SST datasets enables the St-1 age model to be extended to cover the period from February 1995 to January 1999.

C2.7 Razak et al. (2017)

Samples myra-30 (RA17MYR01) and myra-31 (RA17MYR02) are both *Isopora palifera* corals harvested from Myrmidon Reef in May 2013 (Razak et al., 2017). The age models were created for archiving in the GBRCD based on published information from Razak et al. (2017). A chronology was assigned using QAnalySeries to align Sr/Ca minima (maxima) with Myrmidon SST maxima (minima) for fortnightly averaged SSTs from a composite of 10 AIMS in situ loggers. Outliers were removed from the Sr/Ca records to match values reported in Razak et al. (2017). No outliers were removed from other measured trace-element ratios.

C2.8 Sadler et al. (2016b)

All modern and Holocene coral records from Heron Reef published in Sadler et al. (2016b) (SA16HER01b–SA16HER06b; modern: P HS 1, P HS 3, P HS 4, and P HS 7. Holocene: R9C, R15B3) were publicly archived with time series for all data points expressed as calendar year integers (i.e. all data from 2014 had an age listed as 2014). Therefore, to recreate the seasonal cycle (as presented in Sadler et al., 2016b), the chronology was assigned by tying Sr/Ca minima (maxima) to bimonthly averaged SST maxima (minima) using QAnalySeries. The original coral chronologies and Sr/Ca–SST calibration for the modern records were created using the Commonwealth Scientific and Industrial Research Organisation/Pacific Marine Environmental Laboratory Moored Autonomous pCO2 (MAPCO 2) project in the Wistari Channel (Sadler et al., 2016b), but this was not available for the GBRCD. For the GBRCD, modern SST data were averaged from AIMS in situ temperature loggers. The AIMS data loggers from the region have patchy temporal coverage, so the bimonthly SST dataset is an average of data logger data from Erskine Island (×1), Halftide Rocks (×1), Halfway Island (×2), Heron Reef (×16), Square Rocks (×2), and Tryon Island (×2). For the Holocene corals, the SST data used to reconstruct the age model were a generalised seasonal cycle based on the AIMS bimonthly averaged SST data for the southern GBR region (SST minimum occurs in July–August). Holocene corals were dated at the Radiogenic Isotope Facility, University of Queensland, as described in Sadler et al. (2016b). However, no measurement date for U-Th analysis was published. To determine the coral ages relative to the Common Era, the measurement date was determined using the Radiogenic Isotope Facility records (personal communication T. TS16 Clark, June 2015).

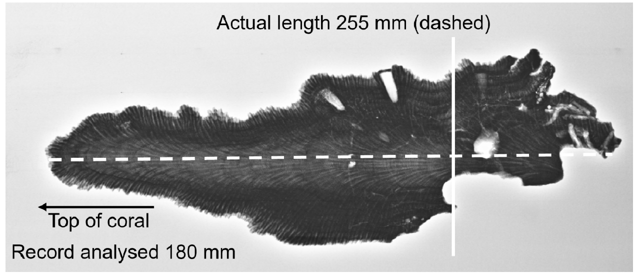

Figure C3. X-radiograph (positive) of Dip-04 (AR24DIP01) coral. The dashed white line indicates the track analysed with white solid line the end of record section. X-radiograph supplied by T. TS17 Razak.

C2.9 Xiao et al. (2020)

10AR2 (XI20ARL01) is a *Porites* sp. coral harvested from Arlington Reef in April 2010 (Deng et al., 2014). The age model was created for archiving in the GBRCD based on information published in Xiao et al. (2020). A chronology was assigned using QAnalySeries to align Sr/Ca minima with the start of each year (i.e. January) to obtain a record with 10–16 data points per year.

C3 Unpublished records

C3.1 AR24DIP01

Dip-04 (AR24DIP01) is an *Isopora palifera* coral that was harvested from Dip Reef in January 1988, which was in an existing collection held at the Australian Institute of Marine Science (AIMS). The data were measured by T. TS18 Razak but have not been published previously. As per the methods described in Razak et al. (2017), ∼ 500 µg of coral powder was milled at 1 mm increments with a 1–2 mm depth using

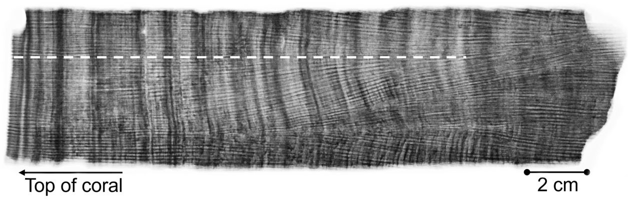

Figure C4. X-radiograph (positive) of GUT12 (AR24OTI01) coral. The dashed white line indicates the track analysed by ICP-AES for the record included in AR24OTI01. X-radiographs by PRP Diagnostic Imaging Wollongong.

a hand-held drill with a 1 mm drill bit (Fig. C3). Trace elements (Ba/Ca, Mg/Ca, Sr/Ca, U/Ca, and Y/Ca) were measured using a Thermo X-Series II quadruple ICP-MS at the University of Queensland Radiogenic Isotope Facility following a modified method described in Nguyen et al. (2013). The age model for this study was created by aligning Sr/Ca minima (maxima) with SST maxima (minima) using QAnalySeries. The seasonal cycle pattern was cross-checked with U/Ca data. As no nearby in situ instrumental measurements of SST exist for the period included in the coral record, chronology was established using the HadISST dataset (grid square centred on 18.5° S, 147.5° E). No outliers were removed from the dataset.

C3.2 AR24OTI01

GUT12 (AR24OTI01) is a *Porites* sp. coral that was harvested in May 2012 by J. Mallela from the Gutter in the One Tree Island lagoon. The data have not been published previously. GUT12 was previously sliced into ∼ 7 mm thick slabs, and a section of GUT12 ∼ 15 cm in length was selected for trace-element analysis by A. Arzey (Fig. C4). This section was measured using the AIMS densitometer and examined for diagenetic alteration using a Phenom XL benchtop SEM at the University of Wollongong by A. Arzey. Micro-borer holes and secondary aragonite crystals were present along most of the analysis track with patches of trace amounts of secondary aragonite crystal (< 2 µm) increasing along the measurement track until 100 % of skeleton was covered in secondary aragonite crystals generally between 0–10 µm length (Fig. C5). Overall, diagenetic alteration is at a low level, and the coral skeleton preservation is fair to good. Coral powder was drilled continuously from a ledge at 0.3–0.6 mm increments using a 2 mm TiN-coated end mill to give a resolution of ∼ 17–34 (median 24) samples per year. Mg/Ca and Sr/Ca ratios were measured by inductively coupled atomic emission spectrometry (ICP-AES) at the Australian Nuclear Science and Technology Organisation (ANSTO) with a Thermo Scientific iCAP 7600 series ICP-AES. Data were standardised using measured JCp-1. The coral age model was created using QAnalySeries to align Sr/Ca minima (maxima) with SST maxima (minima) using the fortnightly averaged NOAA Reyn_SmithOIv2 weekly SST dataset, grid centred on 23.5° S, 152.5° E.

C3.3 AR24OTI02 and AR24OTI03

OTI 1-3 (AR24OTI02) and OTI 3-1 (AR24OTI03) are *Porites* spp. corals that were harvested in 2004 from the One Tree Island lagoon by G. Marion. The corals were part of the Enrichment of Nutrients Coral Reef Experiment (ENCORE) (Koop et al., 2001; Steven and Atkinson, 2003) and were transplanted from the reef slope onto the reef flat on 17 January 1995 and stained with Alizarin Red S on 23 November 1995. OTI 1-3 (Fig. C6) was collected from the reference treatment patch reef at ambient levels of nutrients, while OTI 3-1 (Fig. C7) was from the enriched nitrogen treatment patch reef. Both corals were measured by LA-ICP-MS as per methods described in Lewis et al. (2012); corals were analysed using a Varian 820 ICP-MS, with output data smoothed with a 10-point running mean followed by a 10-point mean. The original age model supplied by S. Lewis (where chronology assigned with Sr/Ca minima (maxima) matched to 8 February (8 August)) was adjusted to improve correlation with SST by fitting data to match the annual maxima and minima of a fortnightly averaged NOAA Reyn_SmithOIv2 weekly SST dataset centred on 23.5° S, 152.5° E grid. Each piece was examined for diagenetic alteration by A. Arzey, although due to the absence of information for both pieces the original LA-ICP-MS track cannot be directly matched to the area examined by the SEM. OTI 1-3 and OTI 3-1 show highly variable diagenetic alteration (Figs. C8 and C9). Both corals show above-average levels of diagenetic alteration compared to other corals examined, which may be due to their handling for or the altered nutrient exposure from the ENCORE experiment. There is scope for future research to determine the cause of the abnormal level of diagenetic alteration. Caution should be exercised if using OTI 1-3 and OTI 3-1 for climate assessment, due to the high levels of diagenesis and the corals' use in the ENCORE experiments.

C3.4 AR24OTI04 and AR24OTI05

OTI4_6C (OTI-4-19; AR24OTI04) and OTI4_6D (OTI-4-22; AR24OTI05) were collected from the One Tree Island hole 4 reef core matrix (Davies and Hopley, 1983) at a depth listed as between 5.72–7.47 m (OTI Hole 4 section 6) and estimated to be 6.2 and 6.5 m depth down core, respectively. Both corals were measured by LA-ICP-MS as per methods described in Lewis et al. (2012) and as per AR24OTI02 and AR24OTI03 above. An age model was created by matching the Sr/Ca maxima with SST minima of a generalised SST time series (minimum SST occurs in August). The age model was further refined by adjusting for best fit of U/Ca maxima to SST minima. An off-cut of AR24OTI04 (Fig. C10) and alternate slice of AR24OTI05 were dated in July 2022 at

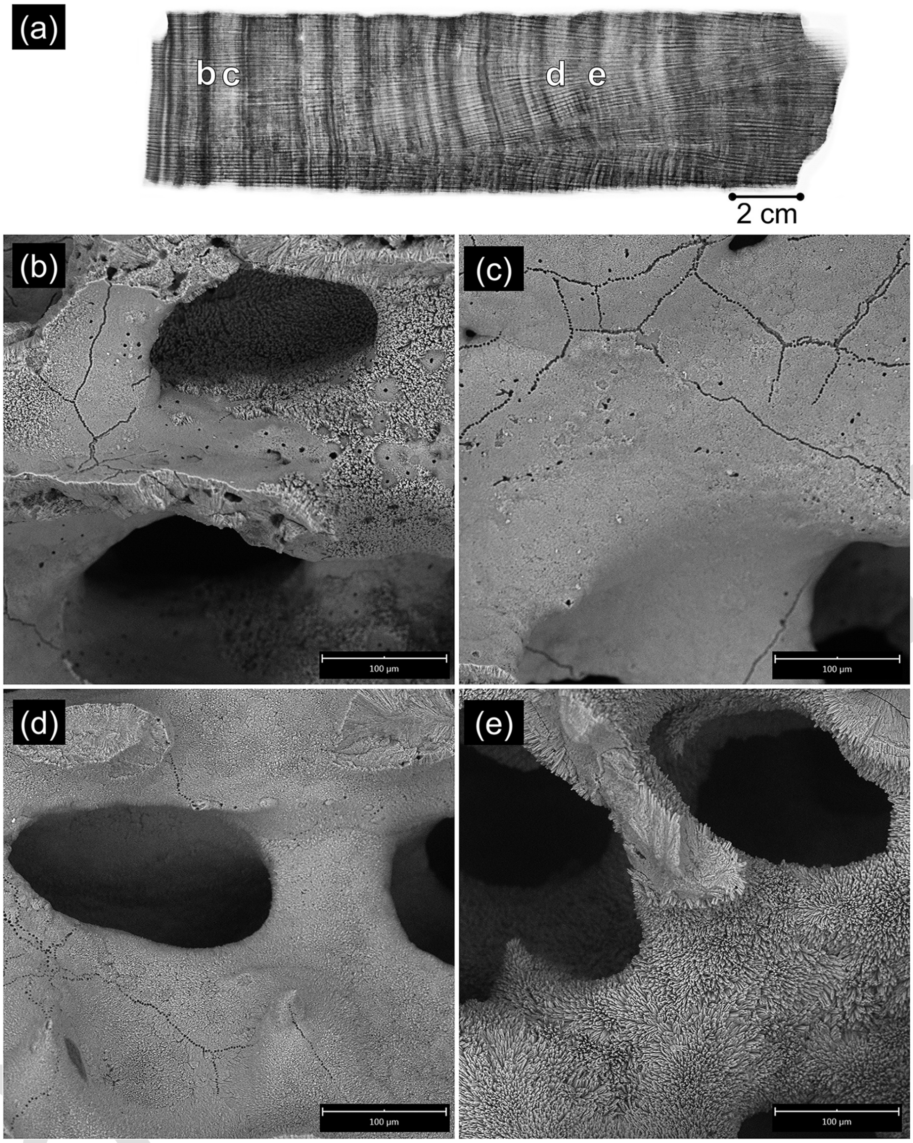

Figure C5. GUT12 (AR24OTI01) SEM images **(a)** Approximate locations of SEM images labelled **(b)**–**(e)** on coral X-radiograph. **(b–e)** Select SEM images from GUT12; **(b)** Secondary aragonite needles ≤ 5 µm patchy cover of coral surface (∼ 50 %) and evidence of micro-borers, **(c)** No secondary aragonite needles. Evidence of micro-borers, **(d)** low-level diagenetic alteration with 100 % cover of secondary aragonite needles < 5 µm, **(e)** low-level diagenetic alteration with 100 % cover of secondary aragonite needles of 5–15 µm. Scale bar indicates 100 µm **(b–e)**.

the Radiogenic Isotope Facility, University of Queensland, to give an age of −3803 ± 13 CE and −3772 ± 11 CE, respectively (Table D1). An alternate slice of AR24OTI04 was also dated in 2022, but the age used for AR24OTI04 is based on the off-cut of the slice that was measured with LA-ICP-MS as the relationship with the section dated for the alternate slice is not certain. SEM screening of the AR24OTI04 coral off-cut indicated 100 % cover of coral surface with secondary aragonite needles generally between 0–10 µm, although small areas with crystals up to 20 µm were observed (Fig. C11).

C3.5 AR24SLY01

The SR coral (AR24SLY01) was measured for radiocarbon by S.TS25 Chakraborty and R.TS26 Bhushan in 1991 at the Physical Research Laboratory in Ahmedabad, India. Annual bands from the SR coral were analysed as per methods described in Chakraborty (1993) for other coral samples. Briefly, the annual samples were cut from the slice using a < 1 mm thickness small diamond wheel operated by an electric hand drill. The cut bands were dried by heating overnight at 80–90 °C, and 15 g of powder was used for the radiocarbon analysis. β counting was carried out using a Packard Tri-

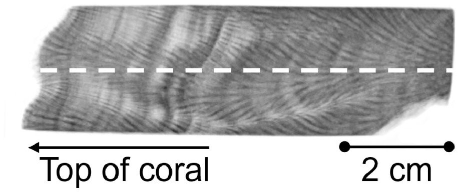

Figure C6. X-radiograph (positive) of alternate slice of OTI 1-3 (AR24OTI02) coral. The dashed white line indicates the estimated track analysed by LA-ICP-MS for the record included in AR24OTI02. X-radiographs by PRP Diagnostic Imaging Wollongong.

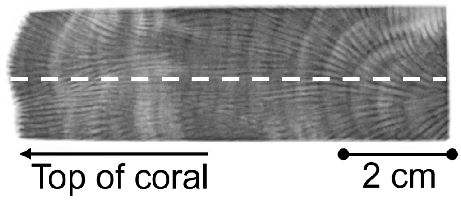

Figure C7. X-radiograph (positive) of alternate slice of OTI 3-1 (AR24OTI03) coral. The dashed white line indicates the estimated track analysed by LA-ICP-MS for the record included in AR24OTI03. X-radiographs by PRP Diagnostic Imaging Wollongong.

Carb liquid scintillator analyser in low-level count mode. The coral X-ray was published in Chakraborty et al. (2000).

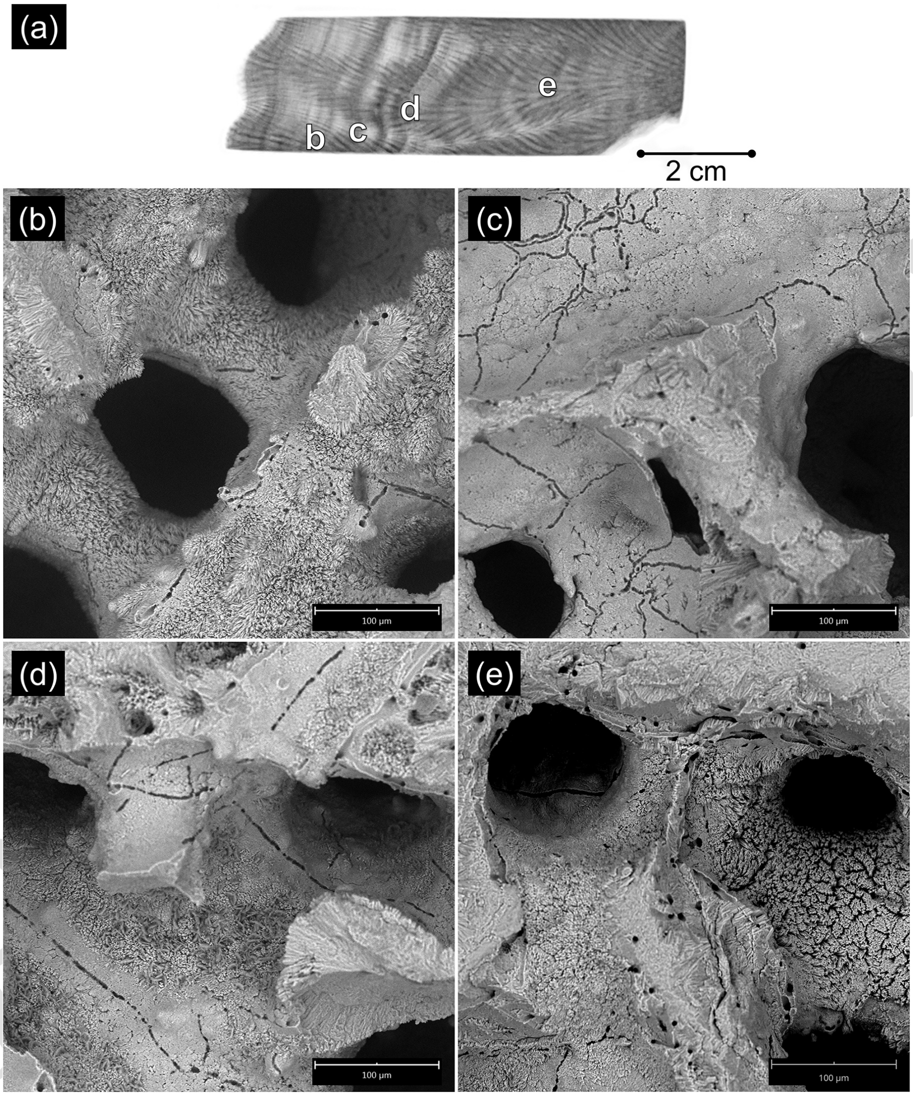

Figure C8. OTI 1-3 (AR24OTI02) SEM images. **(a)** Approximate locations of SEM images labelled **(b)**–**(e)** on coral X-radiograph. **(b–e)** Select SEM images from OTI 1-3; **(b)** low-level diagenetic alteration with 100 % cover of secondary aragonite needles of 5–15 µm and evidence of micro-borers, **(c)** No secondary aragonite needles, with evidence of dissolution and micro-borers, **(d)** Evidence of micro-borers and possibly dissolution. Secondary aragonite needles and calcite crystals (0–10 µm), **(e)** 90 % surface covered by secondary aragonite needles, left side of coral needles are ≤ 5 µm and right side of coral needles are ~ 5–15 µm. Evidence of micro-borers visible. Scale bar indicates 100 µm **(b–e)**.

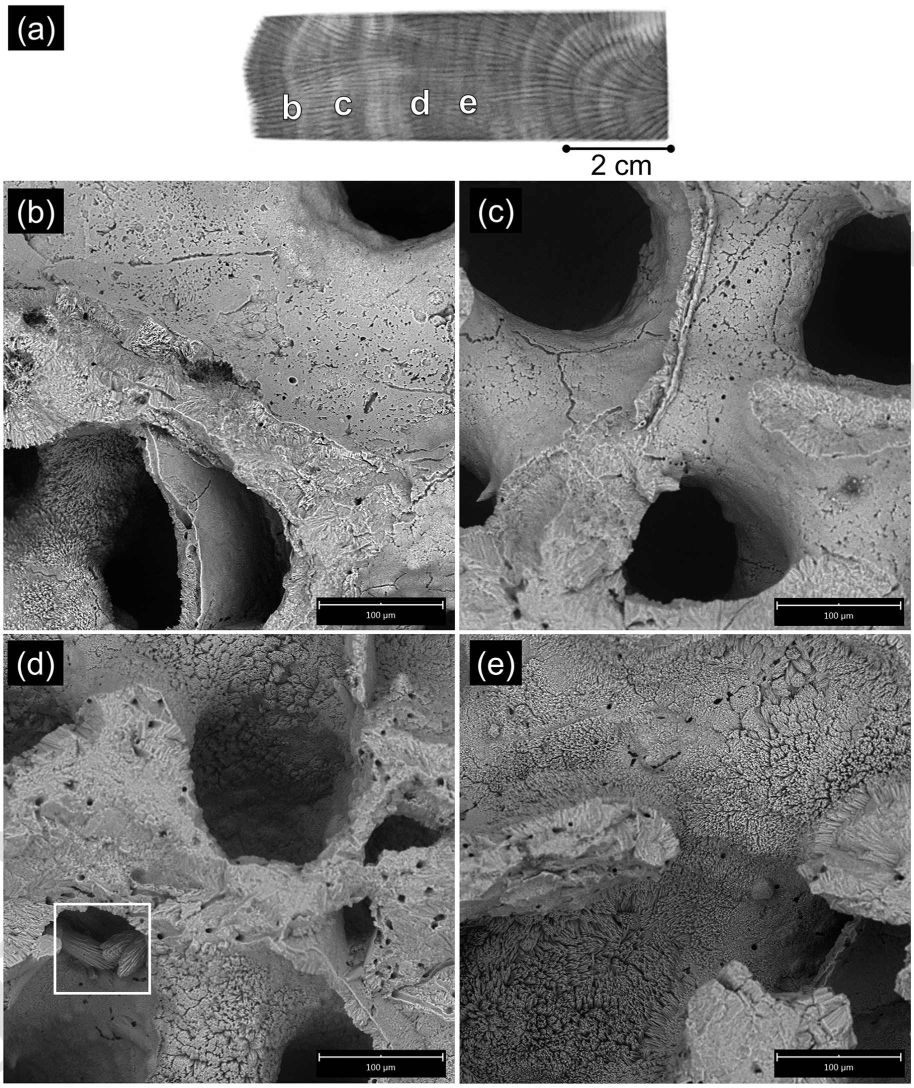

Figure C9. OTI 3-1 (AR24OTI03) SEM images. **(a)** Approximate locations of SEM images labelled **(b)**–**(e)** on coral X-ray. **(b–e)** Select SEM images from OTI 3-1; **(b)** Secondary aragonite needles (0–10 µm) in lower left of image and possible low Mg-calcite cement on coral surface in upper right of image. Evidence of micro-borers, **(c)** No secondary aragonite. Evidence of micro-borers and possible minor dissolution of coral surface, **(d)** 100 % cover with secondary aragonite needles (0–15 µm) with evidence of micro-borers. High Mg-calcite splays occur in pore space (marked by white box), **(e)** 100 % cover with secondary aragonite needles (∼ 5–15 µm) with evidence of micro-borers. Scale bar indicates 100 µm **(b–e)**.

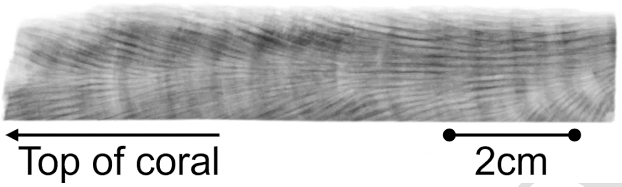

Figure C10. X-radiograph (positive) of OTI4_6C (OTI-4-19; AR24OTI04) coral. Piece is off-cut of the coral piece measured by LA-ICP-MS for the AR24OTI04 record. X-radiographs by PRP Diagnostic Imaging Wollongong.

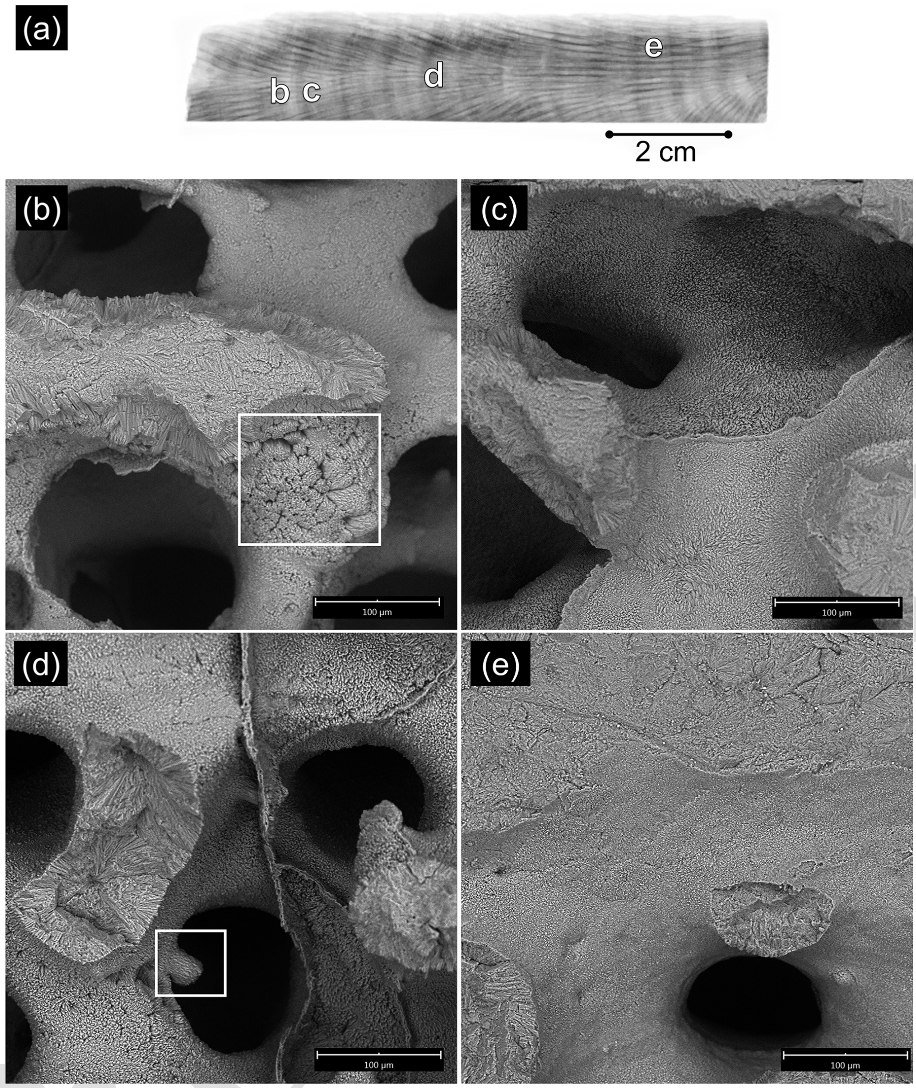

Figure C11. OTI4_6C (OTI-4-19; AR24OTI04) SEM images. **(a)** Approximate locations of SEM images labelled **(b)**–**(e)** on coral X-ray. **(b–e)** Select SEM images from OTI4_6C (AR24OTI04); **(b)** 100 % cover of secondary aragonite needles generally < 10 µm, but section with uneven surface (marked by white box) indicates ∼ 10–20 µm crystals, **(c)** 100 % cover of secondary aragonite needles of < 10 µm, **(d)** 100 % cover of secondary aragonite needles of 5–10 µm. Includes secondary aragonite covering likely fungal growth or part of borer tube that occurred when coral was alive (marked by white box), **(e)** 80 % cover of trace (< 5 µm) crystals of secondary aragonite. Scale bar indicates 100 µm **(b–e)**.

Appendix D: Uranium–thorium dating information

Table D1. Uranium–thorium age data obtained using a Nu Plasma II multicollector inductively coupled plasma mass spectrometer of fossil corals from the Great Barrier Reef, Australia. Note that AA47_OTI-4-19_4_Th and AA_OTI4_6C_1 samples are alternate slices of the same coral piece linked to the GBRCD record AR24OTI04. TS27

Two-component corr. age (CE)	-3803 ± 13	-3812 ± 10	-3828 ± 11	-3838 ± 11	-3772 ± 11	-5755 ± 13	$\delta^{234}U\left(\frac{^{234}U}{^{238}U}\right) \times 1000$ (D2)
Corr. Initial ($^{234}U/^{238}U$)	1.1477 ± 0.0017	1.1481 ± 0.0012	1.1487 ± 0.0013	1.1481 ± 0.0010	1.1480 ± 0.0010	1.1477 ± 0.0011	
Bulk-Earth corr. age (ka)	5.8203 ± 0.0013	5.8301 ± 0.0010	5.8453 ± 0.0011	5.8556 ± 0.0011	5.7901 ± 0.011	7.7698 ± 0.013	
Two-component corr. age (ka)	5.82445 ± 0.013	5.8339 ± 0.010	5.8491 ± 0.011	5.8596 ± 0.011	5.7939 ± 0.011	7.7762 ± 0.013	
Uncorr. age (ka)	5.8306 ± 0.013	5.8386 ± 0.010	5.8537 ± 0.011	5.8564 ± 0.011	5.7985 ± 0.011	7.7815 ± 0.013	
$\delta^{234}U^a$	1.1453 ± 0.0016	1.1457 ± 0.0012	1.1462 ± 0.0013	1.1456 ± 0.0010	1.1456 ± 0.00099	1.1444 ± 0.0010	
($^{230}Th/^{238}U$)	0.05961 ± 0.000010	0.05971 ± 0.000083	0.05989 ± 0.000088	0.05996 ± 0.000096	0.05931 ± 0.00094	0.07882 ± 0.00010	
($^{230}Th/^{232}Th$)	2153.51 ± 3.93	$11\,965.67 \pm 36.99$	$14\,267.90 \pm 34.66$	$14\,211.60 \pm 41.59$	$15\,130.62 \pm 52.18$	7932.69 ± 12.56	
^{232}Th (ppb)	0.2241 ± 0.00023	0.04085 ± 0.00012	0.03442 ± 0.000069	0.03468 ± 0.000086	0.03175 ± 0.00010	0.07492 ± 0.000079	
U (ppm)	2.6683 ± 0.0014	2.6979 ± 0.0013	2.7023 ± 0.0014	2.7092 ± 0.00085	2.6694 ± 0.0016	2.4849 ± 0.0012	
Date of chemistry	4 Jul 2022	4 Jul 2022	5 Jul 2022	5 Jul 2022	4 Jul 2022	5 Jul 2022	
Cleaning method	H_2O_2	H_2O_2	$2 \times H_2O_2$	Water	H_2O_2	H_2O_2	
Lab sample ID (sample ID)	AA47_OTI-4-19_4_Th (OTI-4-19_4)	AA45_OTI4_6C_1_C (OTI4_6C_1)	AA73_OTI4_6C_1_U (OTI4_6C_1)	AA88_OTI4_6C_1_D (OTI4_6C_1)	AA46_OTI4_6D_1_Th (OTI4_6D_1)	AA61_MYR2_16D_1 (MYR2_16D_1)	
GBRCD ID	AR24OTI04	AR24OTI04	AR24OTI04	AR24OTI04	AR24OTI5	MA00MYR02	

Notes on Table D1: TS28

Values in parentheses are activity ratios calculated from atomic ratios using decay constants of Cheng et al. (2000). All values have been corrected for laboratory procedural blanks. All errors reported as 2-sigma TS29. Uncorrected ^{230}Th age (ka) was calculated using the Isoplot/Ex 3.75 software (Ludwig, 2003), where ka denotes thousand years before present, which is defined as 1950 CE9.

To account for non-radiogenic or initial $^{230}Th_0$, two correction factors were applied:

(a) A bulk-Earth correction assuming a non-radiogenic $^{230}Th/^{232}Th_0$ activity value $= 0.825+/-50\%$, with ^{238}U, ^{234}U, ^{232}Th, and ^{230}Th in secular equilibrium.

(b) A two-component mixing correction value determined using the equation of Clark et al. (2014) that accounts for both detrital and hydrogenous $^{230}Th/^{232}Th_0$ shown in Eq. (D1):

$$\left(\frac{^{230}Th}{^{232}Th}\right)_{mix} = \left(\left(\frac{^{232}Th_{live}}{^{232}Th_{dead}}\right) \times \left(\frac{^{230}Th}{^{232}Th}\right)_{live}\right) + \left(\left(\frac{^{232}Th_{dead} - {}^{232}Th_{live}}{^{232}Th_{dead}}\right) \times \left(\frac{^{230}Th}{^{232}Th}\right)_{sed}\right), \quad \text{(D1)}$$

where $^{232}Th_{dead}$ is the measured ^{232}Th value (ppb) in the individual dead coral sample. $^{232}Th_{live}$ is 0.77 ppb, being the mean ^{232}Th value of 43 live *Porites* coral samples from the inshore Great Barrier Reef with a corresponding $^{230}Th/^{232}Th_{live}$ activity ratio of 1.066 ± 0.063 (20 %) (Clark et al., 2012). $^{230}Th/^{232}Th_{sed}$ activity ratio representative of the insoluble Th component incorporated post-mortem or as particulates during growth is assumed to be 0.61 ± 0.12 (20 %). This value is determined from the average *y* intercept values of five $^{230}Th/^{232}Th$ versus $^{232}Th/^{238}U$ isochrons obtained from dead *Porites* corals sampled from the Palm Islands region (Clark et al., 2014).

The values in Table D1 are those determined after calculating the two-component correction. The "Bulk-Earth corr. age (ka)" is supplied to indicate the difference in age calculated between the two corrections (∼ 4–6 years).

Appendix E: GBRCD data resources

AIMS loggers: derived data based on Australian Institute of Marine Science data (https://data.aims.gov.au/aimsrtds/datatool.xhtml, last access: TS30).

Hadley Centre Sea Ice and Sea Surface Temperature (HadISST) (Rayner et al., 2003; https://coastwatch.pfeg.noaa.gov/erddap/griddap/erdHadISST.html, last access: TS31).

NOAA REYN_SmithOIv2 (Reynolds et al., 2002; http://iridl.ldeo.columbia.edu/SOURCES/.NOAA/.NCEP/.EMC/.CMB/.GLOBAL/.Reyn_SmithOIv2/, last access: TS32).

Reefs and shoals – Queensland: Queensland Department of Resources (© State of Queensland (Department of Resources) 2023 (http://qldspatial.information.qld.gov.au/catalogue/custom/search.page?q=%22Reefsandshoals-Queensland%22, last access: TS33).

Drainage basins – Queensland (© State of Queensland (Department of Resources) 2023 (http://qldspatial.information.qld.gov.au/catalogue/custom/search.page?q=%22Drainagebasins-Queensland%22, last access: TS34).

Major watercourse lines – Queensland (© State of Queensland (Department of Resources) 2023 (http://qldspatial.information.qld.gov.au/catalogue/custom/search.page?q=%22Majorwatercourselines-Queensland%22, last access: TS35).

Populated places – Queensland (© State of Queensland (Department of Resources) 2023 (http://qldspatial.information.qld.gov.au/catalogue/custom/search.page?q=%22Populated%20places%20-%20Queensland%22, last access: TS36).

Mainland – Queensland (© State of Queensland (Department of Resources) 2023 (https://qldspatial.information.qld.gov.au/catalogue/custom/search.page?q=%22Mainland-Queensland%22, last access: TS37).

Author contributions. AKA and HVM conceived the study and designed the database. AKA built and curated the database, and database testing was conducted by AKA and HWF. TRC contributed data analysis and advice for U-Th dating. AKA, SEL, JM, JMW, SC, and TBR provided coral data and associated technical information. NPM facilitated converting the database to LiPD format, and AKA and HWF provided example scripts for using the database in R and Python. AKA and HVM wrote the manuscript with input from TRC, JMW, SEL, JM, NPM, HWF, SC, TBR, and MJF.

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Figure 1 was generated using QGIS 3.22.11 (https://www.qgis.org, last access: TS39), with GIS layers sourced from the State of Queensland (Department of Resources), found at http://qldspatial.information.qld.gov.au/catalogue/ (last access: TS40). The full list of GIS layers is available in Appendix E.

Figures 3–5 were generated using R 4.3.1 (https://www.R-project.org/, last access: TS41) with the ggplot2 3.4.3, sf 1.0-14, and ozmaps 0.4.5 R packages found at https://cran.r-project.org/web/packages/ggplot2/index.html (last access: TS42), https://cran.r-project.org/web/packages/sf/index.html (last access: TS43), and https://cran.r-project.org/web/packages/ozmaps/index.html (last access: TS44).

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