

Interactive comment on “Bioavailable Soil and Rock Strontium Isotope Data from Israel” by Ian Moffat et al.

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Reviewer Comment #1: I would like to say that the manuscript innovates by measuring bioavailable strontium isotope ratio of paired soils and underlying bedrock across Israel. The nature of the study is exploratory, and as such it can be used as archival dataset for future studies. Still the manuscript needs to go through substantial revisions before it can be approved for publication because of the following major concerns: Methods: mapping scale is questionable, consideration for sampling locations is unclear; soil and rock sampling strategy (surface, depth) is missing. Sampling permit? Sample processing and data quality assurance is only partially described.

Results: deflation of variability in the region because of a couple of igneous rock sam-

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ples differences in the range of 0.7050 – 0.7090 become almost invisible. The incorporation of rhyolite and quartz makes little practical sense, those are only found in very localized hyper arid region in the North West tip of the Arabian plate (AKA Eilat Mountains). Hard to accept elevated $87\text{Sr}/86\text{Sr}$ ratio both absolutely >0.7092 (in sedimentary bedrock soils) and relatively >0.7058 in volcanic rock are not questioned by the authors. I fear the case of spec resin contamination, check blanks results.

Author Response: The authors would like to thank the reviewer for their constructive and comprehensive review. As the concerns listed here are repeated below in the detailed comments, they are addressed individually through this document.

Reviewer Comment #2: Line 11: Abstract. “Strontium isotope ratios of biogenic carbonates such as bone and teeth”. This sentence is erroneous; bone and teeth are made of carbonate apatite. The strontium is not found in carbonate, it substitutes calcium in apatite.

Author Response: Thank you for the comment, this has been amended in the manuscript.

Reviewer Comments #3: Line 84: The use of 1:200,000 scale geological map is unclear to me, the Geological Survey of Israel provide much more precise and updated 1:50,000 scale geological maps.

Author Response: We chose to use the 1:200,000 scale geological maps rather than the excellent and very detailed 1:50,000 scale maps as this research was focused on obtaining strontium isotope values from the geological units which outcrop most widely across Israel, rather than investigating geographically smaller units. Should a denser sampling program be undertaken we would certainly recommend the 1:50,000 scale maps for that purpose.

Reviewer Comments #4: Lines 83– 86: were soil samples collected from the surface? Was there a consideration of soil depth or removal of topsoil? How were sampling lo-

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cations determined? It is unclear if samples were collected from undisturbed environments, or perhaps from anthropogenically affected areas (agriculture, roads, industrial and residential pollution). If the sampling locations were chosen in protected areas (parks, and nature reserves) was sampling permission granted to the authors?

Author Response: Thank you for pointing out the ambiguity in the text about sampling procedures, we have provided additional information to clarify this. To answer these questions: soil samples were collected from the surface, and a single sample was collected, with no attempt made to sample different soil horizons. Undisturbed locations were chosen where possible, and no samples were collected from parks or nature reserves.

Reviewer Comments #5: Line 92: "rock samples were crashed to a medium powder. . .", I suggest taking out the arbitrary word: medium from the sentence.

Author Response: Thank you, this had been amended.

Reviewer Comments #6: Lines 96-97: ". . . evaporated until dry, before being dissolved in 2ml of 2M high purity nitric acid evaporated until dry and then dissolved in 2ml of 2M high purity nitric acid". I might misunderstand but It looks like the same step was repeated twice?

Author Response: Thank you, this has been amended.

Reviewer Comments #7: Lines 98 – 99: Strontium concentration is measured by ICP-AES, what is the error on the measurement (I'm used to concentration measurement with ICP-MS with higher precision)?

Author Response: ICP-AES normally has an error of ~1%. This is sufficient for the purpose of this research, which was optimising our column chemistry.

Reviewer Comments #8: Lines 109 - 110: what is the analytical error on the measurements?

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Author Response: We aren't certain exactly what you refer to here however have reported the analytical error to 2 standard deviations for all strontium isotope measurements and have provided SRM987 standard measurements in the updated manuscripts.

Reviewer Comments #9: Line 113: Sr isotope ratio results should be reported in up to 4 positions from the decimal point (any additional position is meaningless). 0.705772 should be $0.7058 \pm 2\sigma$. It is customary to report strontium isotope ratio ± 2 standard deviations.

Author Response: The isotope ratios have been amended to 5 decimal places, following a comment from reviewer 1. The error is 2 standard deviations.

Reviewer Comments #10: Line 117: $^{87}\text{Sr}/^{86}\text{Sr}$ is a simple ratio. The use of the term "value" is meant specifically in the stable isotopes terminology to describe a normalized isotopic ratio (a ratio in a sample corrected against a ratio in a standard). Correct throughout the text.

Author Response: Thank you for your comment, this has been amended throughout the text.

Reviewer Comments #11: Line 138 – 140: The highly radiogenic $^{87}\text{Sr}/^{86}\text{Sr}$ ratios of Saharan dust reported from Krom et al. 1999 are measured on silicious grains, those are not bioavailable! For bioavailable strontium isotope ratios see Herut et al. 1993 Doi: 10.1016/0012-821x(93)90024-4. For atmospheric contribution see Hartman and Richards, 2014 <http://dx.doi.org/10.1016/j.gca.2013.11.015>; finally, for past changes in bioavailable Saharan dust contribution see high resolution data from Soreq Cave, Israel by Ayalon et al. 1999 doi: 10.1191/095968399673664163. I also suggest the authors to read again Cohen-Haliva et al. 2012 doi:10.1016/j.quascirev.2012.06.014 they specifically refer to silicate vs. carbonate strontium sources.

Author Response: Thank you for providing this additional, very useful, background

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information about the regional strontium isotope values in the region.

Reviewer Comments #12: Lines 158 – 160: Hartman and Richards 2014 did not measure bedrock $87\text{Sr}/86\text{Sr}$ ratios from basalt units.

Author Response: In Table S3 of the online supplementary material from Hartman & Richards (2014), bedrock strontium isotopes are listed from basaltic units. These values were not referenced to another study, and so it was assumed that they were measured during this study. We apologise for this oversight, as the main text does refer to Weinstein et al. (2006), and this section has been amended in the text.

Reviewer Comments #13: Line 179: Kurkar soil with $87\text{Sr}/86\text{Sr} > 0.7092$ (modern seawater ratio) is highly unlikely. Quoting Shewan 2004 in Lines 183 – 184 as comparable result 0.7097 is equally problematic. At least Shewan question sampling location as possible explanation for exceptionally radiogenic ratio of 0.7100.

Figure 1: the volcanic bedrock $87\text{Sr}/86\text{Sr}$ ratios look problematic (0.7058 – 0.7063) – see Weinstein et al. 2006 10.1093/petrology/egi1003, who measured consistent bulk bedrock ratios between 0.7032 – 0.7034 across Pliocene – Pleistocene basalts in Israel. Is there a valid explanation to such a large discrepancy? When it comes to volcanic bulk and biogenic fraction, I do not think there should be a big difference.

Figure 2: check all the ratios between 0.7092 – 0.7095 excluding those coming from soils that developed over the Arabian plate igneous rocks (southernmost brown symbols on the map). Those are impossible ratios.

Author Response: For these three comments, the authors acknowledge the reviewer's concerns regarding these values and their detailed knowledge of the strontium isotope composition of these geological units, but stand by our measurements and analytical methods. The methods used to extract bioavailable strontium from soils have been found to extract between 0.1-62% of whole soil strontium (Chadwick et al. 2009, doi: 10.1016/j.chemgeo.2009.01.009), which may partially explain the differences in stron-

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tium isotope ratios between this study and others which have measured whole soil or rock samples. The aim of this data paper is not to resolve all ambiguities between our research and other studies but to present all the data collected. We thank the reviewer for this comment and we hope that this manuscript encourages further research into the bioavailable strontium isotope values of these units.

Reviewer Comments #14: Figures 3+4: the inflation in the scales caused by the display of rhyolite ($n=1$) and granite ($n=1$) causes a complete deflation of the rest of the dataset. It is not surprising the authors treat the rest of the dataset as homogeneous.

Author Response: It was not the authors intention to communicate that the rest of the dataset is homogenous, and the plots were deliberately displayed in two panels to try and show both the entire dataset and the subset without the high Sr isotope ratio samples. The granite sample was not included in the 'part b' plot in each instance, but the rhyolite rock sample has also been removed now from part b, we hope this makes the dataset clearer as shown below.

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