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Effects of terrestrial alteration on meteorites from cold and hot deserts

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Meteorites are invaluable tools to study the formation and the evolution of the solar system. However, by their fragile nature, and notably the presence of FeNi alloys, they can degrade very fast at the surface of the Earth. This underlines the importance of return sample missions with the aim to bring back pristine samples, but also urges us to investigate how meteorites can be affected by their presence on Earth before being collected.

Alteration will notably modify the trace element contents and sometimes isotope ratios as well. Among trace elements, rare earth elements (REE) are particularly important as those elements are used as diagnostic features for planetary differentiation, and Sm-Nd and Lu-Hf radioactive chronometers are heavily used to date geological processes. Here, we synthesize REE and isotopic data obtained on ordinary chondrites from both cold (Antarctica) and hot (Sahara, Lut, and Atacama) deserts.

It has been widely showed that hot desert meteorites can be heavily altered by terrestrial alteration. However, all deserts do not show the same degree of alteration, likely related to their climatic conditions, and counterintuitively, visual alteration does not always correlate with chemical modifications [1]. Alteration can have a large impact with the more mobile light (L)REE being enriched up to 8 times compared to the chondritic baseline obtained with fall meteorites [1]. On the other hand, Antarctic meteorites have been considered as globally pristine. We observe this is the case globally, even though some Antarctic meteorites can also be heavily impacted by alteration, showing REE content being now lower than the chondritic baseline [2]. When looking at isotope compositions, the most impacted Antarctic meteorites still show less variations than hot desert meteorites [2-3]. Those results do not prevent the use of hot desert meteorites but advocate for a careful estimation of terrestrial alteration before any isotopic measurements.

[1] Pourkhorsandi et al. (2017), *MAPS* 52, 1843-1858.

[2] Maeda et al. (2021), *GCA* 305 106-129.

[3] Pourkhorsandi et al. (2021), *Chem. Geol.* 562 120056.