Abs. 6024

A PUZZLING FRAGMENT FROM THE DYALPUR UREILITE: ANOMALOUS COMPONENTS, MICROSTRUCTURES, AND GEOCHEMISTRY

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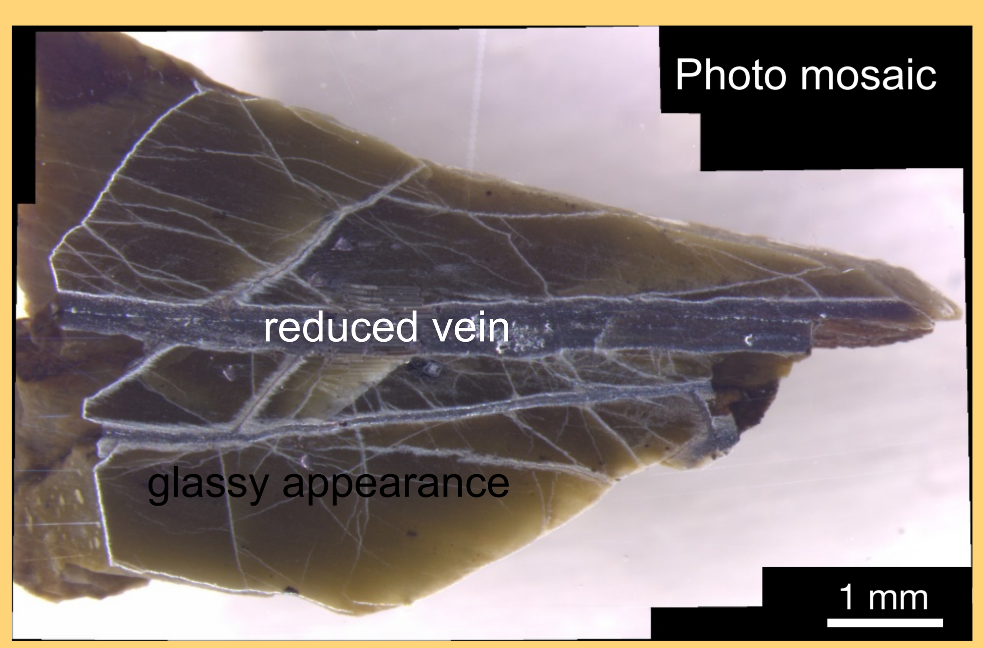
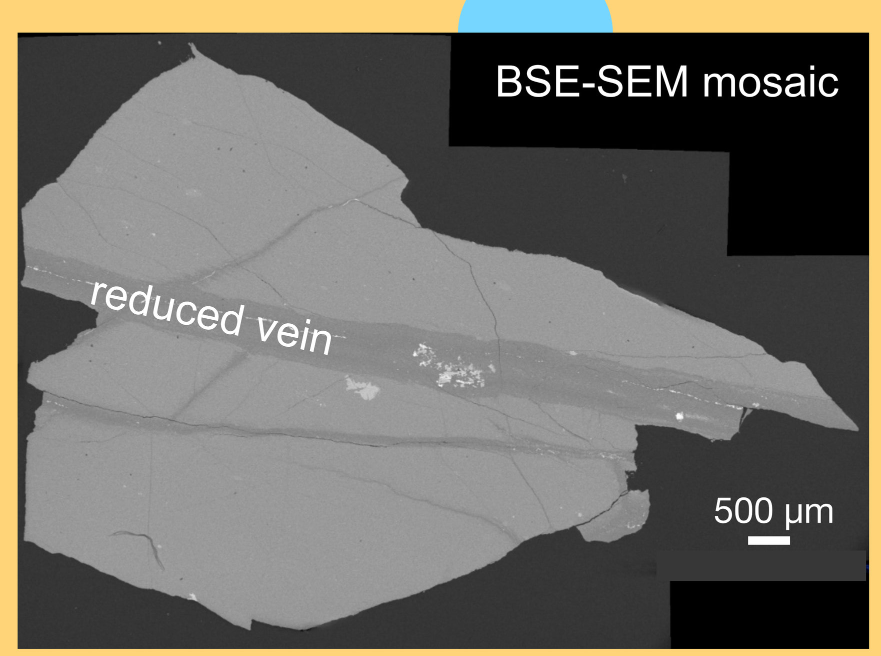
Introduction: Ureilites are ultramafic achondrites, likely mantle restites from a disrupted asteroid, whose detailed petrogenesis is still debated [1,2]. **Dyalpur** is a typical monomict breccia ureilite, recovered after a fall in 1872 in India [1]. The fragment of Dyalpur investigated in this study with other ureilites revealed unique petrographic and geochemical features, which are not consistent with the earlier analyses of Dyalpur [1 and A. Ross 2021, personal communication] and those of other ureilites [1-4].

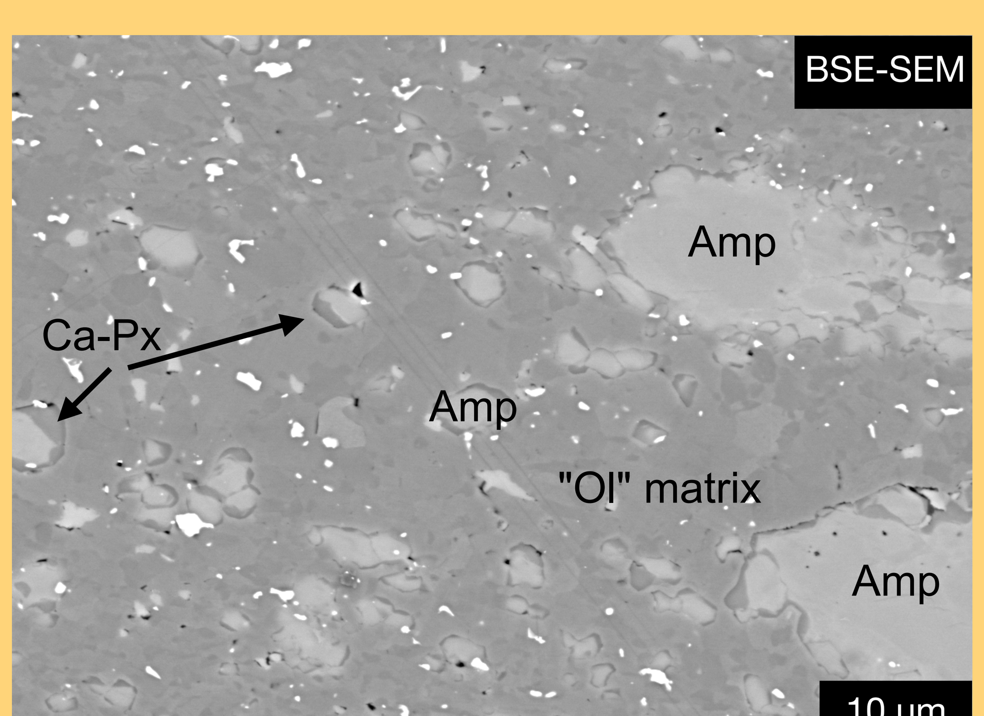
Is this a mix-up in the lab or an exceptional discovery?

Methods: The BM.51185 polished mount was prepared at the Natural History Museum in London (UK) in 2019, chipping a fragment from a specimen of Dyalpur meteorite. The mount was then investigated by µXRF (VUB), SEM (VUB and NHMW), EMPA (NHMW), and LA-ICP-MS (UGent). The same mount was analyzed by SIMS for oxygen isotopic composition at the Centre de Recherches Pétrographiques et Géochimiques (CRPG, Nancy, France).

Results:

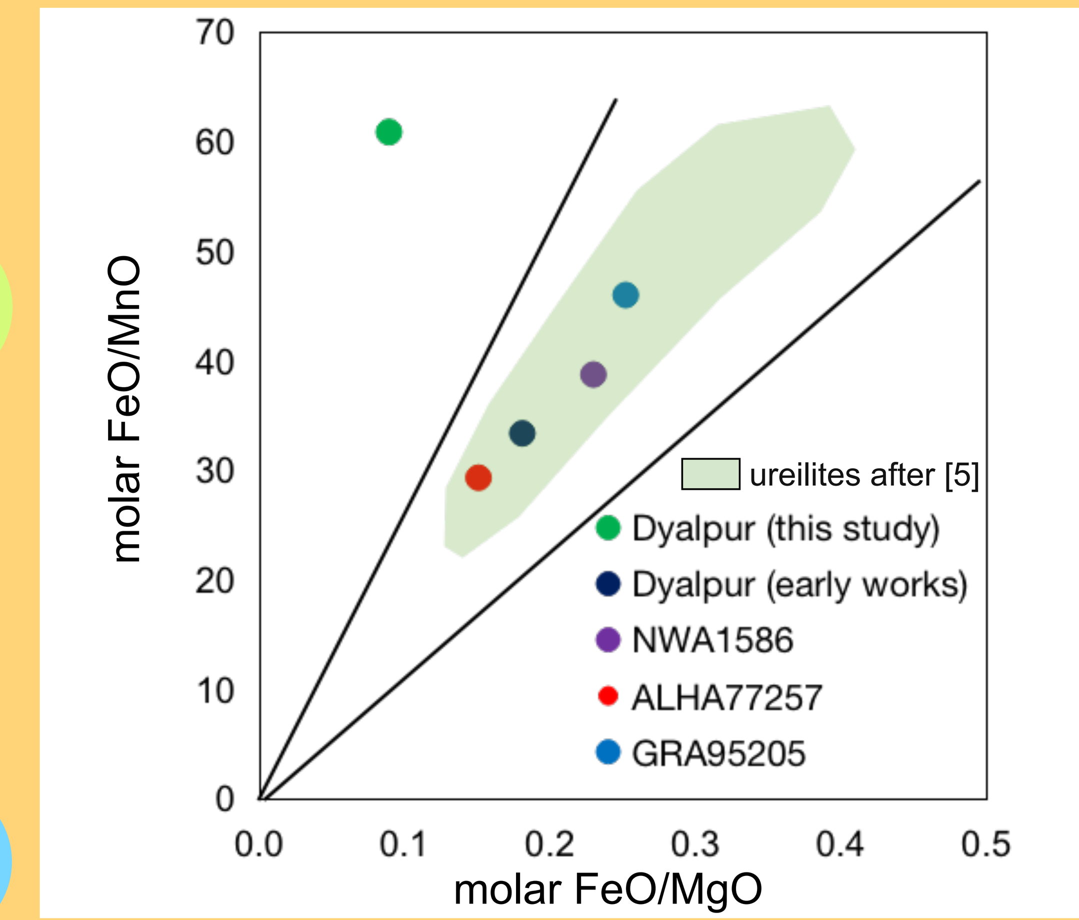






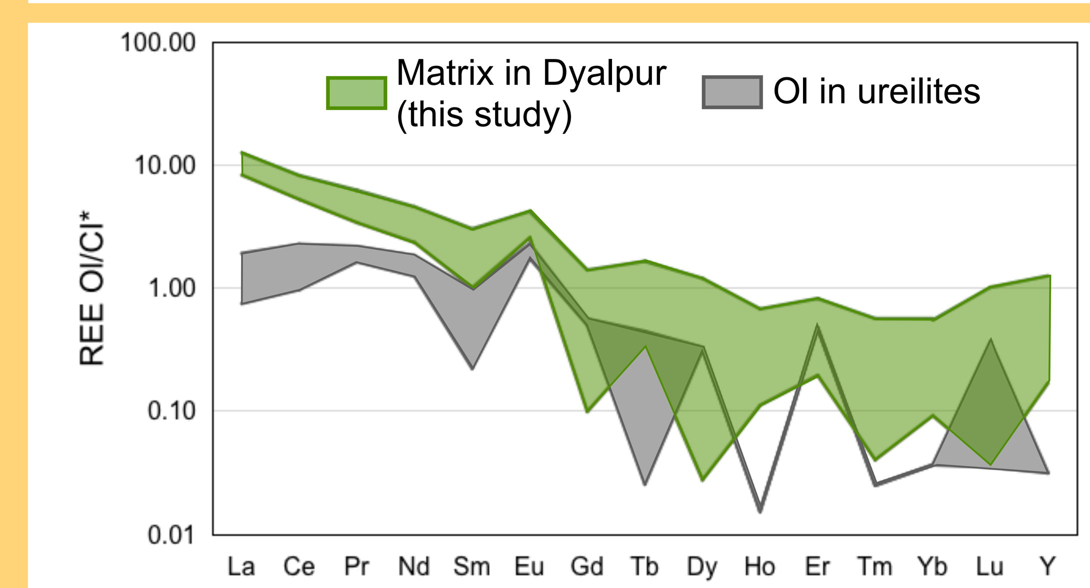
The glassy "homogeneous" host consists of pargasite-hornblende **amphibole** (Amp) clasts in an apparently glassy groundmass, containing micro-domains with **olivine** (Ol; Fo_{91}) and **pyroxene** (Px; En_{90}) composition, and Fe-Ni-Co sulfides (pentlandite Ni_9S_8 and heazlewoodite Ni_3S_2). Amp clasts locally display a Ca-Px ($Wo_{28}En_{69}Fs_3$) rim.

The reduced veins are filled with mainly graphite, with olivine clasts, chromite and troilite.

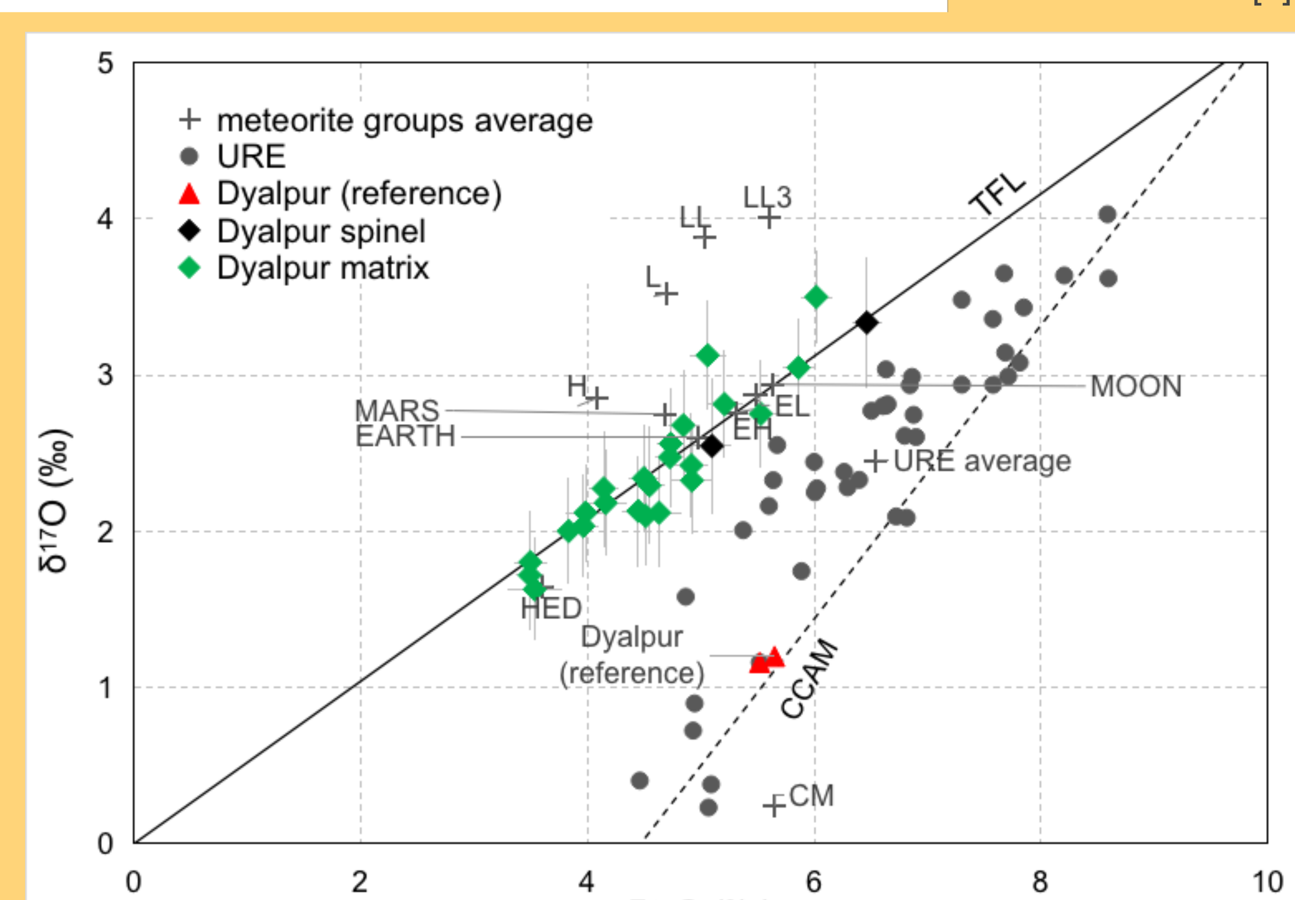


Molar FeO/MgO vs. molar FeO/MnO in olivine in ureilites after [5]. Cloud for ureilites from [5], named ureilites from this study. EMPA data.

Major- and trace element compositions of olivine and low Ca-pyroxene are different from those reported in the literature for ureilites and from previous analysis of Dyalpur fragments. NiO content is up to 0.4 wt% in the investigated fragment.



REE pattern. LA-ICP-MS data. CI* after [6]



Triple oxygen isotope analysis confirms the mismatch with previous measurements on Dyalpur meteorite and on other ureilites, but also lies on the terrestrial fractionation line (TFL).

Discussion: The BM.51185 fragment presents petrographic, geochemical and isotopic characteristics that are not consistent with ureilites. Was it chipped from a meteorite? The following table presents the observations for and against an extraterrestrial origin.

Extraterrestrial origin	Terrestrial origin
- Mg-rich Ol and Px	- amphibole
- high Ni content	- oxygen isotopes
- strongly reduced	

Conclusions?

If we assume that the mount BM.51185 is indeed a fragment of Dyalpur, it represents a rare pocket of melt, cumulate, or xenolithic clast in the ureilite breccia, where a water-rich (altered?) lithology has been reduced by contact with an ultramafic melt, later crosscut by C-rich veins.

If we assume that the mount BM.51185 was accidentally mixed-up with another meteorite or rock during preparation, we wonder what it can be, because the combination of observed characteristics hardly match with either the most common terrestrial rock types, or with common meteorite varieties.

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References: [1] Goodrich C. A. (1992) *Meteoritics & Planetary Science* 27:327–352. [2] Bischoff A. et al. (2014) *Proc. Natl. Acad. Sci.* 111:12689–12692. [3] Ziegler K. et. al. (2021) *LPSC 52*, Abstract #2548. [4] Collinet M. & Grove T. L. (2020) *Meteoritics & Planetary Science* 55:832–856. [5] Goodrich C. A. & Delaney J. S. (2000) *Geochimica et Cosmochimica Acta* 64:149-160. [6] Dauphas N. and Pourmand A. (2015) *Geochimica et Cosmochimica Acta* 163:234-261.