The origin of TTGs inferred from high-precision HFSE measurements

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There is an ongoing debate as to whether Archean TTGs have formed by melting of mafic subducted crust in the garnet-amphibolite or in the (rutile-bearing) eclogite stability field (e.g. [1],[2]). High-field-strength element ratios of TTGs can potentially help to settle this debate, as they mirror the residual mineralogy of these TTG sources. We have carried out high-precision Nb/Ta, Zr/Hf, and Lu/Hf measurements by isotope dilution on 3.85 to 2.8 Ga TTGs from SW-Greenland and India using the Neptune MC-ICP-MS at Bonn. In combination, major and trace element data have been obtained by XRF and quadrupole ICP-MS. Migmatitic gneisses display exceptionally high Nb/Ta (23-42), reflecting secondary intra-crustal melting processes. Excluding these samples, pristine early Archean (3.85-3.6 Ga) TTGs exhibit Nb/Ta from 10 to 24, meso- to late Archean (3.3-2.8 Ga) TTGs from 11 to 32. Ratios of Zr/Hf and Lu/Hf overlap between the two groups, ranging from 31 to 46 and 0.006 to 0.051, respectively. In both groups, Nb/Ta increases with Gd/Yb, La/Yb, Zr/Sm, and decreases with Lu/Hf. There is no correlation of Nb/Ta with Zr/Hf or Zr/Sm (31–151). These compositional systematics are best explained by melting of typical Archean tholeiites in both the garnet-amphibolite (10-15 kbar) and rutile-bearing eclogite stability field (>15 kbar), with subsequent mixing of melts generated from both sources.

Notably, the early Archean and meso- to late Archean TTGs all display both low Ni (<20 ppm) and Cr contents (<14 ppm), indicating no significant interaction with mantle wedge peridotite. Hence, these systematics would be consistent with alternative models for TTG generation arguing for thickened mafic crust as being a likely source for the TTGs. However, as one mixing end-member originates from the eclogite stability field, the minimum thickness of such mafic crust would need to be at least ca. 30 km.

[1] Foley *et al*. (2002) *Nature* **417**, 837-840. [2] Rapp *et al*. (2003) *Nature* **425**, 605-609.

Messinian gypsum stromatolites – A molecular approach

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The Messinian Salinity Crisis (5.96 – 5.33 Ma) resulted in deposition of massive evaporitic sequences throughout the Mediterranean area. Stromatolitic fabrics in Messinian gypsum deposits have been reported from different locations including Crete, Cyprus, and the Northern Appenines (Italy) [1, 2]. These stromatolites are characterized by abundant filamentous textures, which have been interpreted either as remains of cyanobacteria [1] or algal mats [2]. Similar textures were identified in Messinian limestones and were interpreted as faecal pellets of brine shrimps [3, 4].

In this study we apply lipid biomarker analyses and compound-specific stable carbon isotope ratio measurements to elucidate the origin of these filamentous textures. We extracted Messinian gypsum samples from different locations containing filaments. The extracted gypsum samples were subsequently dissolved and extracted once more to recover lipids preserved in the crystalline lattices. Comparison of extracts prior and subsequent to gypsum dissolution enabels us to determine whether the lipid biomarker patterns reflect the conditions during gypsum formation, comprising molecular fossils derived from organisms that represent or produced the filaments.

[1] Rouchy & Monty (2000) *in* Riding & Awramik (Eds.) *Microbial Sediments, Berlin, Springer*, pp. 209-216. [2] Vai & Ricci-Lucchi (1977) *Sedimentology* **24**, 211-244. [3] Decima *et al.* (1988) *J. Sed. Petrol.* **58**, 256-272. [4] Guido *et al.* (2007) *Palaeogeogr. Palaeoclimatol. Palaeoecol.* **255**, 265-283.