Microscale characterization of the organic matter in extraterrestrial samples

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Organic matter is a minor component of most extraterrestrial materials, which are generally dominated by silicate grains. The organic matter in meteorites is frequently concentrated, either by water extraction or by acid-dissolution of the silicates, for analysis with conventional laboratory techniques. However, concentration destroys the geological context of the organic matter. We have characterized the organic matter in interplanetary dust particles (IDPs) and meteorites using a Scanning Transmission X-Ray Microscope and a micro-Fourier Transform Infrared Spectrometer in order to preserve the geological context. This allows us to:

1) Determine the size-scale of heterogenity of the organic matter, with both IDPs [1] and the Tagish Lake meteorite [2] showing several distinct Carbon X-ray Absorption Near Edge Structure (XANES) spectra over a size scale of a few microns;
2) Associate specific types of organic matter with non-Solar isotopic abundances (excess of D or ^{15}N, which are believed to identify material that formed in cold molecular clouds [3]), thus characterizing the interstellar carrier phase [4], and;
3) Test proposals that the organic matter formed by catalytic reactions on mineral surfaces by comparing the organic matter that coats different types of mineral grains.

Preservation of the geological context of the organic matter in extraterrestrial materials provides new insights into the origin of the organic matter in our Solar System and the composition of interstellar organic matter.

[1] Flynn G. J., Keller L. P., Feser M., Wirick S., & Jacobsen, C. (2003) *Geochim. Cosmochim. Acta* **67**, 4791-4806. Flynn, G. J., Keller, L. P., Jacobsen, C., & Wirick, S. (2002) *Lunar & Planetary Science XXXII*, Abstract #1593. [3] Messenger, S. (2000) *Nature* **404**, 968-971. [4] Keller, L. P., Messenger S., Flynn G. J., Clemett S., Wirick S., & Jacobsen C. (2004) *Geochim. Cosmochim. Acta* **68**, 2577-2589.

Thermochronological and structural analysis of the geodynamic evolution of Ribeira Belt, SE Brazil

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This study integrates thermochronological data on the central segment of Ribeira Belt (SE Brazil) with structural analysis of the Paraiba do Sul River megashear in order to constrain the thermotectonic evolution of this Panafrican granulite belt. Our new data indicate that the main regional high grade thrust deformation (D_2: 250º, 55-70º NW; stretching lineation 55-65º, 5-20º) was coeval with peak metamorphism at ~565 Ma [1], post-dating earlier collision related imbrication nappe thrusts at 630-600 Ma (D_1). D_1 and D_2 strain markers were mostly erased by D_3 thrusting and long-term dextral transpressional shearing (50-65º, 70-85º NW; stretching lineation 5-15º, 172-178º), simultaneous with slow-cooling (<1 to 5ºC/Ma) of the orogen until ~ 500 Ma. Brittle, extensional, tectonic event D_4 (290-320º, sub-vertical) and thermal relaxation is associated with late granite emplacement at 490 Ma, being followed by regional tectonic collapse that resulted on rapid cooling (~30ºC/Ma) of the high grade rocks at ~470 Ma. Results suggest that a ~35 Ma period of nearly orthogonal shortening between the San Francisco and West Congo cratons occured until 565 Ma with development of a D_2 flower thrust system, coeval with high-grade granulitic metamorphism. Afterwards, orthogonal compression became rheologically impossible because rocks could not absorb further shortening and D_3 dextral transpressive regime became dominant (at least) from ~560 Ma to ~500 Ma, turning the flower structure asymmetric. Specific positioning within the flower structure and strong deformation partition induced “local” antithetical sinistral kinematics within the main regional dextral regime and differential exhumation: granulites in the central axis were rapidly exhumed, whereas along the lateral branches, because of the small dip angle (5 to 10º), granulites were slowly exhumed, resulting in very slow cooling on the lateral branches (<1ºC/Ma), that lasted for almost 100 Ma.

FAPESP, POCA-PETROLOG (CEGUL, UI: 263; POCTI/FEDER) and SFRH/BD/17014/2004 FCT PhD scholarship co-financed by FEDER provided support for field and analytical work.

[1] Bento dos Santos *et al.* (2007) *Geochimica et Cosmochimica Acta* **71**, 15, Sup. 1, A79.