Energy content of soil organic matter as studied by bomb calorimetry

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Calorimetry has been applied to the study of soil organic matter for decades. Differential scanning calorimetry (DSC) has been the most widely used technique: this method submits the soil sample to a controlled temperature increase (often, 10°C per minute), and records the energy released by the combustion of organic matter. The components of organic matter (cellulose, lignin, polyphenolics, etc) have contrasting ignition temperatures; thus the graph of energy released *versus* temperature characterizes a given substrate [1]. In spite of the obvious attractive of this technique, it has the problem that during the temperature increase (and as a consequence of it) some components of the sample may volatilize before being affected by combustion, a fact that may result in underestimations of the amount of energy stored within the structure of the organic matter under study.

Bomb calorimetry is an alternative procedure. This technique does not allow a detailed study of the release of energy along a range of temperatures, because it gives just a single value, the total energy released by the combustion of the sample. Nevertheless, since the combustion occurs within a closed vessel, no losses of material occur. Therefore, the recorded release of energy reflects the amount of energy stored in the sample probably better than DSC techniques.

We applied bomb calorimetry to quantify the energy stored in soil organic matter in a set of mediterranean forest soils, under *Pinus halepensis* and over calcareous substrates (limestones, marls, etc). Methodological problems were observed; for instance, for soil samples below 7% of OC it was not possible to start a combustion by the standard method (electrical flash in the O_2-saturated vessel), and a comburent was needed.

The amount of energy released was linearly related to the organic carbon content. The relationship was very close, with r^2 values higher than 0.9. Translated to stored energy per unit of organic matter, the obtained values were around 34 Joules per mg C. This ratio, however, was not constant, for it increased with the total organic matter of the sample. In soil horizons very rich in organic matter (some OH horizons) it can reach almost 40 Joules per mg C, whereas it may drop down to less than 30 in mineral soil horizons. The relationships between energy stored and characteristics of the soil organic matter are under study.

[1] Rovira *et al.* (2008) *Soil Biol. Biochem.* **40**, 172–185.

Basaltic magmatism and mantle metasomatism in the Rio Grande Rift

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The Rio Grande Rift in the southwest United States provides an excellent opportunity to investigate temporal and spatial variations in mantle sources and basaltic magmatism in an active continental rift setting. The Rio Grande Rift, extending from northern Mexico to northwest Colorado, has undergone varying amounts of extension, with extension decreasing to the north. Prior rheological studies have indicated that metasomatism and hydration may have a significant effect on the strength of the lithospheric mantle. Here we combine primitive melt inclusion geochemistry (major-, trace-, and volatile elements), whole rock Sr-Nd-Pb isotopic analysis, and tomographic imaging to examine potential mantle metasomatism and its effects on basaltic magma compositions in the Rio Grande Rift.

Melt incusions and whole rock compositions are screened for potential crustal contamination based on negative correlations between Cl/K and Ba/Nb as described by Rowe & Lassiter [1]. Here we focus on Cl variations in melt inclusions, specifically variations in Cl/Nb, to identify mantle metasomatism. The only significant temporal variation along the rift in Cl/Nb is in the southernmost region where the highest Cl/Nb ratios are observed in olivine-hosted melt inclusiosn from a ~37Ma basalt (~150 Cl/Nb) compared to melt inclusions from a young (<50ka) basalt (~10 Cl/Nb). Correlations between age of magmatism, Cl/Nb, and whole rock ^{143}Nd/^{144}Nd, particularly in the southern rift segment, indicates changes in Cl/Nb are likely related a transition from lithospheric to asthenospheric melting over time.

For basaltic volcanism younger than 5 m. y. the highest Cl/Nb ratios are in the central Rio Grande Rift, suggesting little systematic Cl/Nb fluctuations along the rift (N to S). However, for young volcanics, tenative correlations between whole rock Pb isotopes and mantle seismic velocity models (Vs/Vp at 60-100km depth) may further support diverse mantle sources for basaltic magmatism.

[1] Rowe & Lassiter (2009) *Geology* **37**, 439–442.