High-pressure calibration of the oxygen fugacity recorded by garnet bearing peridotites

VINCENZO STAGNO, CATHERINE A. MCCAMMON AND DANIEL J. FROST

Bayerisches Geoinstitut, Universität Bayreuth, D-95440, Germany (vincenzo.stagno@uni-bayreuth.de)

The oxygen fugacity within the Earth's upper mantle below ~50 km depth can be measured by performing oxy-thermobarometry determinations on garnet bearing mantle xenoliths. The commonly used equilibrium includes the $Fe_3Fe_2Si_3O_{12}$ garnet component. A knowledge of the mantle oxidation state is important in order to understand the speciation of heterovalent elements and C-O-H-bearing volatile-rich phases.

To date, measurements have shown that the upper mantle (>250 km depth) is typically characterized by a heterogeneous fO_2 between -1 to -5 log units relative to the FMQ oxygen buffer. This range mainly arises from the pressure dependence of the employed oxybarometer, which drives the fO_2 to lower values with increasing pressure.

The aim of this study was to investigate the iron oxidation state of garnet equilibrated with carbonate and graphite/diamond in a typical peridotite mantle assemblage in order to test the current oxythermobarometer at high pressure. Experiments were performed using a layer of garnet sandwiched between oxygen buffering carbon/carbonate bearing assemblages, which fixed the oxygen fugacity at known values at pressures between 3 and 7 GPa and temperature of 1100-1600 °C. Several configurations were tested either in the presence of natural Cr-bearing garnets or hydrous conditions and empolyong both relatively reduced and oxidized starting materials. fO_2 was measured using a sliding redox sensor assemblage empolying Fe-Ir alloy. Using these measurements a re-evaluation of the oxy-thermobarometer calibration was performed. Redox profiles for cratonic mantle were reexamined with implications for carbon speciation in the mantle.

Assessment of carbon needs to renew soil fertility

FOTINI E. STAMATI[1]*, NIKOLAOS P. NIKOLAIDIS[1] AND JERALD P. SCHNOOR[2]

[1]Department of Environmental Engineering, Technical University of Crete (TUC), University Campus, 73100, Chania, Greece
(*correspondence: fotini.stamati@enveng.tuc.gr)
[2]Department of Civil and Environmental Engineering, 4105 Seamans Center, The University of Iowa, Iowa City, Iowa 52242

Conversion of natural to agricultural ecosystems induces SOM losses due to changes in land management practices and reductions in litter input. The average rate of soil organic carbon (SOC) stock decline after the conversion of a native land to cropland decreases in time [1] and depends on the previous landuse type (forest, grassland, shrubland), and the decomposition regime (determined by climatic conditions, size of the carbon litter input, texture and other factors). SOC can be depleted by 50% in about 5 years in the tropics and 50 years in temperate ecoregions. On the basis of soil resilience and sustainability of agriculture, the adoption of appropriate agricultural practices for the maintenance of carbon in croplands is a win-win situation because they will prevent erosion and contribute to inherent soil and product quality, biodiversity, fertility, water quality, and agricultural economy [2]. Monitoring field data and modeling exercises are essential for the assessment of the turnover of different carbon pools in order to optimize organic input strategies for carbon sequestration in stable forms so as maintain soil structure and fertility [3]. In this work, grassland to cropland and forest to cropland conversions under different climatic regimes were modeled with ROTH-C. Chronosequence literature data for dryland steppes [4], temperate grasslands [5], mediterranean shrublands [6] and forests in the tropics [7] were used for the modeling. The methodological approach for model caibration and estimation of uncertainty presented by Stamati *et al.* (2011) [4] was followed. Appropriate carbon addition under different climatic regimes and soil textures are suggested for sustainable agricultural practices (carbon sequestration, HUM increase).

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