Phosphorus mobility in lake sediments

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For several decades, the paradigm that phosphorus release in sediments is the consequence of the absence of oxygen in the hypolimnium is recurrent among limnologists. At that time, the relation between the reduction of Fe (III) complexes and phosphorus (P) release in anoxic sediments was stated as hypothesis and later demonstrated. Although the theoretical statements matched the practical findings, these could not be generalized since several field observations and laboratory experiments lead to other conclusions. This has lead to a need of deeper understanding of factors that influence the phosphorus mobility besides oxygen concentration.

P mobility in lake sediments was assess through a microcosm experiment. Sediments from Lake Furnas (Portugal) were examined through a P sequential extraction procedure before and after a shift in redox potential achieved by means of O_2 concentration variation. Microsensors were used to measure pH and O_2 concentration in the sediments, during oxic and anoxic periods. The sediments that were under anoxic conditions released P from Fe minerals (BD fraction) compared with the initial conditions. The P bounded to Al minerals remained approximately the same comparing with the initial conditions (NaOH fraction), indicating the this fraction remains stable with redox potential changes. When the reactor was exposed to O_2, Fe minerals re-adsorbed P which is consistent with the classical paradigm. However, we found that Al minerals released P in the oxic phase of the experiment leading to a P concentration raise in water column. The reason was not due directly to O_2 concentration but to a raise in pH. A possible explanation is related with the recent findings that oxygen in the oxic layers could oxidize H_2S in deeper sediment layers trough a microbial network connected with nano-wires from H_2S in the deep anoxic sediment layer to oxygen in the upper layers, with concomitant pH raise.

Calcium minerals bounded to P remained stable between anoxic and oxic conditions (HCl fraction), as well as the refractory pool (NaOH 85 °C). P bounded to Al and Fe represent the most mobile fraction and is an indicator of exhaustion of sediments' retention capacity.

Zoned calc-silicated boudins in quartz-pelitic metatexitic rocks, NW Portugal

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In the coastal zone of NW Portugal, at north of Porto, a banded and sheared migmatitic structure outcrops, with a general NNW-SSE to NW-SE trend. This structure shows strong asymmetric interlayer folds with generally subvertical axes, plunging to SE. Metatexites are widely prevalent, over diatexite lithologies. These are leucocratic to mesocratic with no foliation or locally with an incipient one, with a very irregular orientation. The metatexite lithologies present a well defined foliation in the metapelitic or quartz-pelitic melanosome, trending N160°-N175°, 75°-90° NE, or N15°, 90°, but with considerable dispersion. The neosome occurs as irregular lenticules, elongated parallel to this foliation.

Calc-silicated rocks occur in small ovoid or ellipsoid bodies, always with internal zoning, more or less concentric: in the core, a zone of granoblastic texture with quartz +clinopyroxene+wollastonite+garnet+sphene+ plagioclase +/- biotite, surrounded by a zone of granoblastic texture of lower granularity with quartz+biotite+plagioclase+sphene+ garnet+/- clinopyroxene+amphibole. The outer zone (metatexites) is more irregular and presents heterogranular texture with variation in the % of biotite associated with quartz, muscovite and feldspar +/-sillimanite. The core zone of the ellipsoid bodies is relatively richer in CaO and Al_2O_3 while the intermediate zone is enriched in SiO_2 and Na_2O. The surrounding metatexites present higher content of K_2O and similar content of Na_2O, regarding the buffer zone.

The foliation of the metataxites is deflected around the calc-silicated ellipsoidal bodies of variable size (5 cm to 1 m), and its major axis elongation has general direction NNW-SSE, parallel to the foliation of the surrounding migmatites. These bodies represent 'resister' of palaeosome in the migmatites that have undergone metasomatism during the migmatisation and boudinage during the coeval shear deformation of the surrounding metaxites, trending NNW-SSE. The protolith of these calc-silicated rocks may be a Ca-rich quartz-pelitic metasedimentary rock. It is thought to correspond to a Ca-plagioclase-rich greywacke.

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