Ultrasteep composition gradients within ankerite grains from regionally metamorphosed marls

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Ankerite (Ank) grains frequently contain cores of almost pure dolomite (Dol) in the garnet zone and at lower grades of three areally extensive stratigraphic units from both Buchan and Barrovian terrains in northern New England, USA. Dol cores and Ank rims have Fe/(Fe+Mg) in the range 0.006-0.011 and 0.16-0.23, respectively. Ank grains with dolomite cores have many features closely analogous to K-feldspar rims around albite cores produced experimentally by incomplete hydrothermal reaction between albite and KCl solution [1]: (a) Ank-Dol contacts are irregular but sharp at the micron scale, (b) The orientations of the Ank and Dol crystal lattices are identical, (c) Fe/(Fe+Mg) of Ank is often slightly greater at the Ank-Dol contact than further away, (d) The Ank-Dol contact is often decorated with open pores. Based on these similarities, Ank appears to have replaced detrital Dol by a dissolution-reprecipitation mechanism during diagnesis or very low grade regional metamorphism.

Fe/Mg was measured across 11 Ank-Dol contacts in 4 samples with the Cameca NanoSIMS 50L at Caltech using a ~700 nm diameter ion beam and across one contact with the Philips CM300 FEG TEM at Johns Hopkins University using a ~120 nm electron beam. Background-corrected ion or X-ray counts were calibrated against the composition of Ank measured by electron microprobe in each sample. Composition profiles were inverted following [2] to estimate values of Dt (D is the Fe-Mg interdiffusion coefficient in Ank/Dol, t is time). Values of Dt measured by NanoSIMS and TEM are $(1.5\text{-}11)\cdot 10^{-13}$ m^2 and $(1.2\text{-}1.3)\cdot 10^{-14}$ m^2, respectively (the latter smaller because of the smaller electron beam). Using Fe-Mg interdiffusion in olivine [3] as a proxy for that in Ank/Dol, the profile measured by TEM implies that neither peak T = 500-550°C nor linear cooling from 550° to 200°C lasted longer than 1000 years. Results support other recent evidence for rapid heating and cooling during regional metamorphism (e.g., [4]). Our preliminary data beg for precise measurement of the rate of Fe-Mg interdiffusion in Dol and Ank.

[1] Niedermeier *et al.* (2009) *CMP* **157**, 65-76. [2] Vielzeuf *et al.* (2007) *CMP* **154**, 153-170. [3] Dohmen & Chakraborty (2007) *Phys. Chem. Minerals* **34**, 409-430. [4] Ague & Baxter (2007) *EPSL* **261**, 500-516.

History of atmospheric deposition of mercury reconstructed from sedimentary records corrected for diagenesis

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We measured the vertical distributions of Hg and ancillary parameters in sediment cores and porewater in a perennially oxic and a seasonally anoxic basin of an oligotrophic headwater lake of the Canadian Shield. The only input of anthropogenic Hg to this lake, whose uninhabited watershed has not been affected by wildfires or wood harvesting, comes from atmospheric deposition. Vertical distribution of porewater Hg in the perennially oxic basin was relatively monotonous suggesting that Hg was not produced to or consumed from the porewater during the early stages of diagenesis at the sampling time. In the seasonally anoxic basin, depth distribution of dissolved Hg exhibit higher Hg concentrations in the water overlying the sediment than in the porewater and a progressive decrease in porewater Hg concentration over a 5-cm sediment depth interval, whether or not the bottom water was anoxic at the sampling site.

Porewater Hg profiles are modelled with a one-dimensional transport-reaction equation to obtain the rate of Hg removal from porewater. This information is then used to estimate authigenic Hg; substracting authigenic Hg from the measured solid Hg and correcting for basin-specific processes allow the reconstruction of atmospheric Hg deposition chronology. This calculation indicates that authigenic Hg was negligible in the perennially oxic basin and represented ≤ 10% of total solid Hg in the seasonally anoxic basin. It also shows, consistently in both basins, that atmospheric Hg deposition flux has increased almost linearly from the end of the 19th century to the mid-1970's. For the next three decades, however, a different trend in Hg fluxes among basins is revealed, possibly due to the fact that the two basins have not been affected the same way by the export of Hg stored in the watershed or to a non-steady state diagenetic effect. This illustrates the complexity of interpreting sedimentary archives of Hg.