Influence of model aggregation on the parameterization of biogeochemical reaction kinetics in ecosystem models

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Marine biogeochemical models focusing on organic matter production and consumption are compared to study the effects of complexity on model results. The various models differ in their level of spatial and biogeochemical detail. Reduction of biogeochemical complexity is performed by aggregating the highly detailed, physiologically based, MIRO model (Lancelot *et al*., 2005). In particular, we investigate the relevance of biogeochemical rate constants, determined in situ or through lab experiments, for ecosystem modeling. Results show that models characterized by distinct levels of spatial resolution provide different quantitative estimates of the biogeochemical rates, especially those strongly influenced by the system's heterogenity. An aggregation of different functional groups or the microbial loop also requires an adaptation of reaction rate constants. The rate constants of the aggregated model have to account implicitely for the processes, which are no longer explicitely included. A direct transfer of rate constants determined experimentaly or by the calibration of other models is thus strongly dependent on the respective model formulation.

References

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Contrasting evolutionary trends in magnetite from carbonatites and alkaline silicate rocks

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Magnetite (Mgt) is a common accessory mineral in carbonatites and associated alkaline rocks, and a sensitive petrogenetic indicator. We examined the chemical evolution of Mgt in calciocarbonatite (MCrb) and ijolite (MIj) from Kerimasi, Tanzania. MCrb is characteristically enriched in Mg (0.18-0.32 apfu), Mn (0.05-0.14 apfu) and Al (0.01-0.26 apfu), but depleted in Ti (0.04-0.11 apfu) with respect to MIj (< 0.08 apfu Mg, 0.03 apfu Mn, 0.04 apfu Al, and > 0.21 apfu Ti). MCrb has much lower levels of Cr, V, Co, Ni and, to some extent, Nb (≤ 16, 1210, 120, 100 and 17 ppm, respectively), but noticeably higher Zn (1310-2770 ppm) than MIj (up to 1880 ppm Cr, 1800 ppm V, 190 ppm Co, 210 ppm Ni, 46 ppm Nb and 1150 ppm Zn). The two samples are virtually identical in terms of their Ga, Zr, Hf and Ta contents. MCrb shows a trend of decreasing Ti and increasing Mn (at nearly constant Mg) from the earliest generation to crystallize (macrocryst cores) toward the latest (rims and small groundmass grains). The early generation of MCrb is also distinguished by its higher V, Nb and Nb/Zr values. In ijolite, we distinguished two varieties of magnetite differing in their Mg, Ti, V, Ga, Nb, Ta, Co and Hf contents. The two types are also characterized by very different Zr/Hf and Co/Nb ratios. Both varieties show a trend of increasing Mg, V, Zr, Nb, Hf and decreasing Ti and Ga from the earliest generation (subhedral crystals) to the later-crystallized interstitial grains. There is also a trend of increasing Ta in variety-one magnetite, whereas variety-two is Ta-free. The significant differences in major- and trace-element chemistry of the studied carbonatite and ijolite indicate that these rocks did not originate from a single magma, but are products of two distinct magmas characterized by different distribution coefficients of trace elements with respect to magnetite.