Geochemical Cycling of Major Seawater Components over the Past 150 Ma

Rolf S Arvidson (rsa4046@ruf.rice.edu)¹ & Fred T Mackenzie (fredm@soest.hawaii.edu)²

¹ Dept. of Geology and Geophysics MS-126, Rice University, P.O. Box 1892, Houston TX 77251-1892, USA ² Dept. of Oceanography, University of Hawaii at Manoa, Honolulu HI 96822, USA

Recent models (Hardie, 1996; Spencer and Hardie, 1990) proposed for resolving the Phanerozoic history of seawater emphasize the critical control exerted by MOR hydrothermal brine output, which is scaled to changes in seafloor spreading rate. However, this approach tends to minimize the importance of carbonate mineral formation as a sink and source of dissolved components, and also ignores possible variations in the rate of continental weathering. We contend that a complete picture of seawater compositional history demands resolving quantitatively the complex relationships and feedbacks between weathering, temperature, atmospheric composition, mineral formation, volcanism, tectonism, spreading rate, eustacy, and seafloor basalt-exchange reactions. In pursuit of this understanding, we have developed a quantitative model that describes the geochemical cycling of calcium, magnesium, sodium, potassium, carbon, oxygen, sulfur, and chloride. This model couples the cycling of these components through weathering, oxidation-reduction, metamorphic precipitation, and decarbonation reactions. Although similar to earlier treatments (Berner et al., 1983; Lasaga et al., 1985), it explicitly addresses

the relative importance of dolomitization as a marine versus cratonic burial phase.

We have used this model to compute changes in seawater composition over the past 150 Ma. We compare model results with those observed in the rock record in terms of the relative distribution of dolomite versus calcite. Our model results suggest that changes in the rate of dolomite versus calcite precipitation, driven in turn by changes in temperature and saturation state, exert a fundamental control on seawater composition, and that these variations are reflected in the mass-age distributions of these minerals in the geologic record.

Hardie, LA, Geology, 24, 279-283, (1996).

- Spencer RJ & Hardie LA, *Geochem. Soc. Spec. Pub.*, **2**, 409-419, (1990).
- Berner RA, Lasaga AC & Garrels RM, *Amer. J. Sci.*, **283**, 641-683, (1983).
- Lasaga AC, Berner RA & Garrels RM, *AGU Geophys. Monogr. Ser.*, **32**, 397-411, (1985).