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Mg isotope geochemistry of pore-waters in shelf cores from IODP Expedition 317; Canterbury Basin, New Zealand

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Magnesium is a major element in the geosphere, biosphere, and hydrosphere. In seawater, Mg^{2+} is the fourth most abundant ion with a concentration of 55 mM. The dominant source of Mg to the ocean is chemical weathering of the continental crust, transported via riverine runoff. The Mg sinks are hydrothermal alteration of oceanic crust, limestone dolomitization, and ion-exchange reactions of clay minerals in marine sediments. Profiles of decreasing magnesium in porewaters have been observed in many anaerobic marine sediments such as in the near shore sediments. Cation exchange under reducing conditions results in magnesium removal from porewater, and this removal process account for 5-10 % of the Mg^{2+} brought to the sea by river (Bischoff et al., 1975). These diagenetic chemical reactions are thought to be reflected in the isotopic composition of the pore fluids. Recent developments in inorganic mass spectrometry allowed Mg stable isotope systems to be explored by cosmochemists and geochemists. By this time, little is known about the Mg isotope geochemistry in the interstitial waters of marine sediments. The effects of diagenesis on Mg isotopic composition are of interest in relation to the use of Mg isotope as a tracer of the oceanic mass balance of Mg. It has been demonstrated that modern seawater is isotopically homogeneous (de Villiers et al., 2005) but it should not been maintained following geochemical weathering, authigenic mineral precipitation and ionic exchange among various components. The elemental and isotopic compositions of sedimentary porewater have been extensively used to constrain diagenetic chemical reactions following burial.

In this study we analyzed Mg isotope values of porewater from Integrated Ocean Drilling Program (IODP) Expedition 317 Canterbury Basin Sea Level: Global and local controls on continental margin stratigraphy. This expedition was devoted to understanding the relative importance of global sea level change versus local tectonic and sedimentary processes in controlling continental margin sedimentary cycles. Therefore, the recovered sediments provide geochemically unexplored deep-penetrated cores at shallow shelf sites. Cores were drilled in the eastern margin of the South Island of New Zealand. Upper Miocene to recent sedimentary sequences were cored in a transect of three sites on the continental shelf (Sites U1351, U1353 and U1354) and one on the continental slope (Site U1352). Continental slope Site U1352 represents a complete section from modern slope terrigenous sediment to hard Eocene limestone.

We use Mg isotope ratios of sedimentary porewaters to evaluate the role of Mg-carbonate precipitation/dissolution, Mg-adsorption/desorption between sediments/rocks and porefluid on the Mg isotope composition with the help of other tracers, providing a geochemical framework for an evaluation on the Mg isotope variability. Our aim are to assess the effect of diagenetic processes on the Mg budgets of porewater and bulk sediments using Mg isotope ratios, and to constrain the effect of chemical reactions in the sediments to global Mg isotope cycles.

Keywords: IODP, pore-water, Mg isotope, MC-ICP-MS