Gas hydrate and mud volcanoes offshore Antarctic Peninsula: A geophysical study

U. TINIVELLA*, F. ACCAINO, M. GIUSTINIANI, AND M.F. LORETO

Istituto Nazionale di Oceanografia e di Geofisica Sperimentale, Borgo Grotta Gigante 42C, 34010, Trieste, Italy (*correspondence: utinivella@ogs.trieste.it)

The global warming over the Antarctic ice-cap produces amplified signals, well imaged especially in the transition zone between the Antarctic Peninsula and the adjacent Drake passage. The presence of a diffused and discontinuous BSR was detected during the Italian Antarctic cruise 1989-90 and better defined in a later cruise 1996-97, both onboard R/V OGS-Explora and supported by Progetto Nazionale di Ricerche in Antartide. The seismic data showed a relevant gas hydrate reservoir on the South Shetland margin. In order to quantify the concentrations of gas hydrate and free gas in the pore space, we proposed a procedure based on theoretical model (Biot equations and approximations in case of seismic frequency). This approach models the different layers associated with the BSR (two solids -grains and clathrates- and two fluids –water and free gas-) including an explicit dependence on differential pressure and depth, and the effects of cementation by hydrate on shear modulus of the sediment matrix. The theory gives both compressional and shear wave velocities, and needs easy to hypothesise physical parameters (porosity, compressibility, rigidity, density, frequency dependence). These can be determined from available lithostratigraphic information, and experimental data sets if no direct measurements are available. In particular, a detailed geological knowledge of the area is essential in order to suppose a normal gradients of physical properties (porosity, density, rigidity, and compressibility) of marine sediments, in order to correctly associate the velocity anomalies to chlatrate and free gas presences and avoid misinterpretations, like the case of over- and/or under-consolidated sediments. The concentrations can be estimated by fitting the theoretical velocity to the experimental P-wave velocity obtained from travel-time inversion. Finally, the BSR depth obtained by seismic data can be used to estimate the geothermal gradient fitting the seismic depth of the BSR with the theoretical depth evaluated by using modeling. This procedure was used to analyse the seismic data (multichannel and OBS data) acquired offshore South Shetland Margin, in which there are evidences of gas hydrate and free gas in the marine sediments. We detected also several mud volcanoes and evidences of fluid expulsions.

Process-related Mg isotope fractionation during a seasonal cycle in a granitic catchment

E.T. TIPPER[1], E. LEMARCHAND[1,2], R.S. HINDSHAW[1,2] AND B. BOURDON[1]

[1]Institute of Isotope Geochemistry and Mineral Resources, ETH Zürich, Switzerland (tipper@erdw.ethz.ch)
[2]Institute of Biogeochemistry and Pollutant Dynamics, ETH Zürich, Switzerland

River water elemental or isotopic ratios are controlled by mixtures of end-members with differing compositions. The compositions of such end-members are either inherited from heterogeneity in the original lithological sources (e.g. carbonate, silicate) or from process-related fractionation of elemental or isotopic ratios during weathering. Distinguishing process-related variations from lithological mixing trends is a problem fundamental to partitioning weathering fluxes between different sources, and understanding the underlying mechanisms that control chemical weathering. In many studies, distinguishing chemical signatures in river waters related to lithology from those related to weathering processes is complex because of heterogeneous lithology in most catchments.

In this study the $^{26}Mg/^{24}Mg$ ratios (expressed as $\delta^{26}Mg$) was analysed from a mono-lithological granitic, weathering-limited first order catchment from the Swiss Alps. The Damma glacial forefield (part of the BigLink project), is one of the largest multi-disciplinary experimental catchments of its kind. Water samples were collected every two weeks during the melt season, from five localities. The advantage of having a continuous sequence of samples from the same sites, is the constant lithology over the sampling season.

Mg is one of the major components in the dissolved load of the rivers, and concentrations show variations over the seasonal cycle. These are more complex than dilution with varying runoff. Rather, they relate to mixtures of water bodies with distinct chemical compositions. $\delta^{26}Mg$ in the dissolved load of the rivers has a significantly lower isotopic composition than the granite (greater than 1‰ in some cases), the principal source of Mg to the rivers. This is caused by fractionation of the $^{26}Mg/^{24}Mg$ ratio during weathering, consistent with previous data on Mg isotopes in rivers [1]. Sub-epsilon level analytical precision reveals that the data show a continuous trend in their isotope ratios across a seasonal cycle. The processes behind the seasonal cycle and offset between the granite and the waters will be discussed.

[1] Tipper *et al*. (2006) *EPSL* **250**, 241–253.