

Chemical weathering and regolith development over Rajmahal basalt and Chotanagpur gneiss: A comparative study

PREMCHAND KISKU¹, JITENDRA K. PATTANAIK^{1*},
TARUN K. DALAI¹ AND S. BALAKRISHNAN²

¹Department of Earth Sciences, Indian Institute of Science Education and Research-Kolkata, Mohanpur 741252, INDIA (*correspondence: jitendra.bapi@iiserkol.ac.in)

²Department of Earth Sciences, Pondicherry University, Puducherry 605014, INDIA

Mineralogical, geochemical and field investigations were carried out on weathering profiles developed over Rajmahal basalt and Chotanagpur gneiss in eastern India to study and understand chemical weathering, elemental mobilization and development of regolith. Samples (n=38) were collected from three different locations, including fresh rock, variably weathered saprolite and soil. Variable thickness of soil cover and saprolite was observed in the study area. Fresh Rajmahal basalt consists of plagioclase phenocrysts enclosed by clinopyroxene and plagioclase groundmass, glass and opaque minerals. Chotanagpur gneiss is mainly composed of K-feldspar, plagioclase, quartz, mica and bands of mafic minerals. Weathered basalt shows red coloration along the fractures indicating precipitation of iron oxy-hydroxides.

The Chemical Index of Alteration (CIA) in the weathering profile developed over the basalt and gneiss varies from 40 to 95 and 46 to 85, respectively. High CIA values of pedoliths indicate extensive chemical weathering in the study area. Data of fresh and slightly weathered rocks plot close to the feldspar line in the A-CN-K diagram, indicating that feldspars are the most abundant minerals. Weathered samples show loss of CaO+Na₂O+K₂O, indicating extensive destruction of feldspar and clinopyroxene. XRD analysis shows progressive upward increase of clay mineral abundance in the soil profile. With respect to fresh rocks, Fe, Mn, Ti, Ni, Cr, Zr and Al are enriched, and Ca, Mg, Na, Sr and Si are depleted in the weathered basalt, whereas, in the weathered gneiss Si is enriched and Fe and Mn are depleted. For different elements, zones of leaching and accumulation vary within a profile.

Results of this study bring out the differences in the alteration and weathering of minerals in profiles developed on basaltic and gneissic rock types.

A low blank technique for the measurement of iron isotopes in seawater and results from the tropical Atlantic Ocean

J. K. KLAR^{1*}, R. H. JAMES¹, I. J. PARKINSON²,
E. P. ACHTERBERG¹ AND C. SCHLOSSER¹

¹National Oceanography Centre, University of Southampton Waterfront Campus, European Way, Southampton, SO14 3ZH, UK, (*correspondance: J.klar@noc.soton.sc.uk, r.h.james@noc.ac.uk, eric@noc.soton.ac.uk, cs2u09@noc.soton.ac.uk)

²Bristol Isotope Group, School of Earth Sciences, University of Bristol, Wills Memorial Building, BS8 1RJ, UK, (Ian.Parkinson@bristol.ac.uk)

Iron (Fe) is essential for marine photosynthesis, respiration and nitrogen uptake, but low Fe supply and low solubility under oxic conditions results in Fe-limitation of microbial communities in large parts of the world's ocean. For this reason the oceanic Fe cycle is linked to global carbon cycle. Recent studies [1, 2] have shown that analysis of the Fe isotopic composition can provide unique information about its sources, and Fe cycling within the oceans. Here we present a protocol for the accurate and precise measurement of Fe isotopes in seawater using a low blank, double-spike technique. To this end, Fe is pre-concentrated from seawater using a NTA resin, and then separated from the sample matrix by anion exchange chromatography (AG1-X8 resin). Isotope ratios are analysed by multi-collector inductively coupled plasma mass spectrometry (ThermoFisher Neptune) coupled to a sample desolvator (Aridus II or Apex-Q), and corrected for mass bias effects using a double-spike technique. Our model simulations show that the optimal spike composition is 47% ⁵⁷Fe, 53% ⁵⁸Fe, with a small amount (<0.5%) of ⁵⁴Fe, which allows precise measurements of a wide range of sample to spike mixing ratios, the optimum being ~1:1. The precision of the MC-ICPMS measurements is δ⁵⁶Fe ~0.05 ‰ (2 SD), based on replicate analyses of haematite standards.

We also present results of the preliminary analysis of Fe isotopes in seawater samples (0.2 µm filtered) collected from within the Oxygen Minimum Zone (OMZ) of the tropical Atlantic Ocean along ~12° N (GEOTRACES cruise GA06, 7 depth profiles sampled at 4 to 9 depths, ranging from surface waters to 5600 m depth). Fe concentrations ranged from 1.04 to 3.77 nM within the OMZ (located between 200 and 1000 m depth). The Fe isotope data will be used to (i) identify the sources of Fe to this region, and (ii) to identify processes of Fe cycling in oxygen minimum zones.

[1] Lacan *et al.* (2010) *Anal. Chem* **82**(17), 7103-7111. [2] John & Adkins (2010) *Mar. Chem* **119**, 65-79.