# Gadolinium anomalies in Atibaia River water (SP, Brazil)

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Stable synthetic chelates of gadolinium find wide use as contrast agents for magnetic resonance imaging (MRI). After administration to patients, the chelate is excreted in urine. Anthropogenic anomalies of Gd were measured in river water and groundwater samples by several authors, because the chelates are remarkably stable when passing wastewater treatment plants (WWTP) [1]. Despite that, even in densely populated areas small watersheds should be free of Gd anomalies in absence of discharge of raw or treated sewage.

In this work we studied three small sectors of Atibaia River, in São Paulo state, Brazil. River water was sampled, filtered through 0,22 $\mu$m syringe filters and acidified with distilled $HNO_3$ to pH < 2. Trace elements were measured by ICP-MS, without sample pre-concentration. The results of rare earth elements (REE) were normalized by the PAAS [2].

The first sector is the most pristine among the three. It is upstream, covers about 100 km of the river course and no Gd anomaly was detected in the water samples. The second sector comprises samples from Anhumas Creek, a tributary of Atibaia River, where it crosses an urban area and has two WWTPs. Gd anomalies were present even before the first WWTP, and their magnitude is comparable to anomalies described for some major German rivers [3]. Immediately after the WWTPs, Gd concentration increases reaching the same values of discharged effluents from WWTPs in Bremen (Germany) [3] and higher than those found in Berlin (Germany) [4] and in the Hérault watershed (South France) [5], but lower than in some other Berlin canals [4]. Anomalies calculated as Gd/Gd* [3] resulted in up to fifty-fold enrichment of Gd over background concentrations. The third sampled sector is Atibaia River where it crosses an industrial and urban area, before ending at a dam. In this area, the Gd/Gd* values were only useful to mark an anomaly at the discharge of a WWTP. The other samples showed strong influence of the industrial park, with enrichment in light REE, resulting in a poor Gd/Gd* anthropogenic signal.

[1] Verplanck *et al* (2010) *Environ. Sci. Technol.* **44**, 3876–3882. [2] McLennan (1989) *Rev. Mineral. Geochem.* **21**, 169-200. [3] Kulaksız & Bau (2007) *Earth Planet. Sci. Let.* **260**, 361-371. [4] Raju *et al* (2010) *J. Anal. Spectrom.* **25**, 1573-1580. [5] Rabiet *et al* (2009) *Chemosphere*, **75**, 1057- 1064.

# C-, Cr-, Sr-isotope stratigraphies and rare-earth elements in carbonate and BIFs of the Neoproterozoic Jucurutu Formation, Seridó Belt, NE Brazil

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The Jucurutu Fm. in the Seridó Belt, NE Brazil, encompasses fine- to coarse-grained amphibolites-facies marbles, locally with cross-bedding and stromatolite structures. BIFs of three localities in this belt comprise itabirites (actinolite- or cummingtonite-itabirite) and tremolite schist iron ores and are overlain by marbles of the Jucurutu Formation. Diamictites of uncertain stratigrahic position exhibit clasts up to 0.6 m long (augen-gneisses, quartzites and bi-gneisses) and a fine-grained clay matrix.

C-isotope stratigraphic pathways for the Jucurutu Fm. show negative $\delta^{13}C$ values at the base followed upsection by positive values. At the Ferro do Bonito Mine, values as low as -12‰ are found in carbonates just above the contact with underlying BIF, followed by values ~ -5‰ and then by positive values (+4 to +10‰) upsection. $\delta^{13}C$ values for carbonates that overlie BIFs at Riacho Fundo and at Serra da Formiga are all positive. The difference of $\delta^{13}C$ behavior between basal carbonates at Mina do Bonito (negative) and Riacho Fundo and Serra da Formiga (positive) localities results, perhaps, from different stages of BIF deposition. $^{87}Sr/^{86}Sr$ values for Jucurutu Fm. carbonates lie ~ 0.7074, a value commonly observed in late Cryogenian to early Ediacaran.

BIFs yield negative $\delta^{53}Cr$ values (-0.4 to -0.1 ‰), Ce/Ce* from -0.4 to 0.7 (17 among 21 samples support anoxic depositional environment) and were probably formed as accumulation of $Fe^{+2}$ in an ice-capped anoxic ocean. Their deposition was followed by post-glacial cap carbonate deposition (Ce/Ce* from 0.4 to 0.5) in an oxic environment.

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