Large 3.4 Ga Algoma-type BIF in the Eastern Indian Craton

A.R. BASU[1], P.K. BANDYOPADHYAY[2], R. CHAKRABARTI[1] AND H. ZOU[3]

[1]University of Rochester, Earth & Environmental Scinces, Rochester, NY-14627 (abasu@earth.rochester.edu)
[2]Presidency College, Kolkata, India – 700 073
[3]Earth and Space Sciences, UCLA, CA - 90095

We provide a precise 3.4 Ga ion microprobe U-Pb age of zircons of the Banded Iron Formation (BIF) from the Iron Ore Group (IOG) of the Singhbhum-Orissa Archean craton in eastern India. This result is important because of the early-Archean age and large size of this BIF for the debate on variations in the amount of free atmospheric oxygen during the early-middle-late Archean.

The IOG in the type area of Jamda-Koira valley in the eastern Indian Craton is exposed in an elongated 55x35 km NNE-SSW belt sandwiched between ca. 3.3Ga Singhbhum granite complex to the east and the Bonai granite to the west. Here and in other parts of the craton (lat. 21º 45' and 22º 30'; long. 85º 00' and 86º 00') the IOG represents the most spectacular occurrence of Archean volcano-sedimentary sequence with pristine depositional characteristics preserved without later higher grade metamorphism. The IOG sequence in the type area begins with a lower basaltic-andesitic lava (~2km) at the base, followed successively upwards by lower shale (2.3km) and tuffaceous rocks (30m at the top, gradational with the lower shale), banded iorn ore (0.7km), upper shale with Mn-ore, and upper lava at the top (~3km).

22 zircon grains (~350µm long) seperated from the tuff layer < 1m below the BIF show sharp oscillatory zoning, igneous Th/U=1.7 to 2.5, and a concordant age of 3392±29 Ma (MSWD=10.4). We assign this age to the immediately overlying BIF and also suggest a similar age for all the BIFs belonging to the IOG of this craton. The approximate total size of this Algoma-type BIF of the craton is well over 10^{10} tons, and for the type area where the BIF thickness exceeds 100m and continuous for 50km, we favor a depositional environment in a shallow island-arc/back-arc basin.

Although most workers [1], with some exceptions [2], believe that the early Archean atmosphere had much less oxygen than at present, our results along with the occurrence of other early-late Archean BIFs [3] suggest more investigations are needed to examine variations in free atmospheric oxygen in the early geologic record of the Earth.

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Sulfate and Mercury distributions in a mining impacted watershed in NE Minnesota

TRAVIS K. BAVIN AND MICHAEL BERNDT

Minnesota Department of Natural Resouces, Division of Lands and Minerals, 500 Lafayette Rd., St. Paul MN, 55155, USA (travis.bavin@dnr.state.mn.us, mike.berndt@dnr.state.mn.us)

The Minnesota DNR is examining sulfate (SO_4) loading to the St. Louis River watershed in northeastern Minnesota and possible linkages to mercury (Hg) methylation. SO_4 sources in this region include that released during oxidation of minor sulfide minerals found in taconite mines and associated tailings and waste rock; SO_4 captured by wet scrubbers during combustion of coal; and SO_4 discharged from wastewater treatment facilities. The goal of 2007 sampling was to obtain a regional "snap-shot" of SO_4 and Hg distributions that could be used to plan more comprehensive studies in 2008.

An initial survey was conducted in September, 2007, when the St. Louis River and eight of its major tributaries were sampled for SO_4, $\delta^{34}S(SO_4)$, $\delta^{18}O(SO_4)$, total Hg (THg), methyl Hg (MeHg), dissolved organic carbon (DOC), and other dissolved species. A mining influence is clear as the St. Louis River peaked at 93 mgL^{-1} near the center of the mining district where it was fed by tributaries with SO_4 reaching as high as 127 mgL^{-1}. However, $\delta^{34}S(SO_4)$ values for the tributaries ranged between 2 and 11‰ which was well below the 11 to 15‰ range measured for SO_4 in the main river. $\delta^{18}O(SO_4)$ ranges for the tributaries and river overlapped at 0 to 8.0‰, probably reflecting mixed SO_4 sources (sulfide oxidation and coal combustion). A detailed accounting of the isotopic and concentration data also revealed that our regional SO_4 inventory missed a high $\delta^{34}S(SO_4)$ source in the upper and middle reaches of the river and a high $\delta^{18}O(SO_4)$ source in the lower, non-mining impacted areas.

THg and MeHg concentrations in this initial survey exhibited little, if any, correlation with SO_4 concentration but suggested, instead, strong correlation with DOC and total wetland area in the non-mining impacted streams and with chloride in mining impacted streams.