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Atmospheric conditions at the Archean-Paleoproterozoic boundary: Geochemical studies from Central India

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The Central Indian Craton (also known as the Bastar craton or Bhandara craton) is composed of dominantly Paleoarchean granite gneisses, basic and acidic volcanic rocks, and associated metasedimentary rocks forming greenstone belts of two/three different ages. The Sausar belt on the northern part of the craton comprises several generations of granite gneisses and migmatites, and the metasedimentary rocks of the Sausar Group. The belt shows polyphase deformation and metamorphism, which gave rise to the development of granite gneisses and migmatites, previously grouped under the stratigraphic nomenclature "Tirodi Gneiss". Detailed structural mappings in different parts of the Sausar belt have shown that the regional E-W to NNE-SSW trend of the belt developed during the second deformation [1]. On the basis of wide variations in their ages and relationship with the metasedimentary rocks, the Tirodi Gneiss has been proposed to be distinguished into Tirodi Gneiss – I (an older tonalite-trondhjemite-granodiorite (TTG) suite and younger quartz-monzonite plutons of ~3200 to 2450 Ma, forming the basement complex for the Sausar Group), Tirodi Gneiss – II (granites, gneisses and migmatites formed during first deformation of the Sausar Group at ~2100 Ma), Tirodi Gneiss – III (granites, gneisses and migmatites formed during second deformation of the Sausar Group at 1618±8 Ma) and Tirodi Gneiss – IV (granites, gneisses and migmatites formed during the terminal phase of the second deformation of the Sausar Group at 1454±5 Ma) [2]. The Sausar Group, unconformably overlying Tirodi Gneiss – I, is reported to contain coarse clastics, volcanics, glaciogenic sediments, cap carbonates, and fine clastics with manganese ore deposits [3]. Re-Os molybdenite age data of the calc-silicate rocks of the Sausar Group constrain the age of the Sausar Group to be ~2400 Ma [4].

We have mapped a paleosol horizon at the contact of the Sausar Group) and its basement (Tirodi Gneiss; >2500 Ma) in Central India. Mineralogical studies indicate the presence of unusual minerals such as siderite, ankerite, uraninite, and alumino-silicate minerals in the paleosol. The geochemical data of the paleosol indicate of a reducing environment of formation and oxygen deficient conditions in the atmosphere at the time of development of this paleosol during the Archean – Paleoproterozoic transition. Geochemical data from the cap carbonate horizon above the glaciogenic unit reported from the Sausar Group, and manganese bearing horizons above the cap carbonate confirm presence of reducing environment in the shallow ocean. The lithological associations and geochemical data of chemogenic sediments are comparable with Paleoproterozoic glaciogenic sediments of the Transvaal Supergroup of South Africa, the Huronian Supergroup of Canada and the Turee Creek Group of Western Australia. The geochemical data from these key units developed before the great oxidation events have potential for global correlation.

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