

## Channel accumulations of detrital ferromanganese ores in Western Dharwar Craton, Karnataka, India

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Detrital ferromanganese ores in the Shimoga and North Kanara schist belts of Western Dharwar craton in Karnataka, India, constitute economic grade concentrations and are being exploited since the beginning of the 20<sup>th</sup> century. The ferromanganese ores are fragments of lateritic manganese formed from the supergene alteration of metasedimentary manganeseiferous formation.

Boulders of ferromanganese ore fragments unconformably overlying lateritized late Archean supracrustal rocks occur in sandy-clay beds. The sandy-clay beds attain a thickness of up to 12 m and the ore beds vary in thickness from 1 to 4 m. Majority of the ore fragments are subangular to subrounded and range in size from 10-30 cm. The individual ore fragments exhibit either oolitic/pisolitic or textureless fabric and nowhere fragments exhibiting a mixed fabric within a single boulder is encountered. The ore boulders at places generally exhibit graded bedding, but at places reverse graded bedding is also noted. Mode of occurrence of the detrital ferromanganese ore fragments point to their accumulation in a fluvial regime, whose drainage patterns was possibly governed by the evolution of the western ghats.

Locales of detrital ferromanganese ore accumulations is purported to be along fluvial palaeochannels and appropriately designated as "channel accumulations" to differentiate them from "channel deposits" of iron in the Hamersley basin, Australia. Delineating palaeochannels in the Shimoga & North Kanara regions holds the key to unravel yet undiscovered accumulation of economic grade ferromanganese ores.

## Hydrated metal ions and cluster equilibria: Towards a molecular understanding of ore formation

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Continuing advances in experimental techniques such as uv-vis and vibrational spectroscopy, X-ray absorption spectroscopy, neutron and X-ray diffraction/scattering, potentiometry, conductivity and flow-through solubility measurements under extreme conditions provide ever more sophisticated insight into many aspects of ore metal transport and deposition chemistry. In addition, modern computational approaches (e.g. classical molecular dynamics, ab initio/molecular dynamics, DFT, etc.) also provide elegant molecular insight into hydrothermal processes and compliment the existing and ongoing experimental studies. On-going X-ray absorption spectroscopic and ab initio studies are currently providing new information into the nature of metal complexing under hydrothermal conditions and hence into the transport and deposition chemistry of metals in ore forming systems at elevated temperatures and pressures.

Of particular interest as well, is the formation of cluster molecules in steam and/or low density supercritical water involving the stepwise coordination of solvent molecules to ionic and molecular (uncharged) species over a wide range of temperatures. These water-cluster moieties account for the well known solubility of NaCl and other salts in steam and low density supercritical water in natural hydrothermal, magmatic/volcanic and synthetic energy systems. Molecular metal complexes form clusters with water molecules (e.g. CuCl.nH<sub>2</sub>O) and play a key role in phase separating, ore depositing hydrothermal systems in the Earth's crust in which various components fractionate into a less dense, volatile-rich phase. In addition, ionic species such as hydronium and halide ions form simple cluster molecules with water which are sensitive to water activity (fugacity) and temperature. The formation of proton water clusters, for example, has interesting implications for the definition and understanding of pH in steam. Recent and on-going experimental and theoretical studies of metal complexes and their interaction with water solvent under extreme conditions will be presented together with implications for chemical transport in hydrothermal environments.