Sustainability of groundwater abstraction in the Arsenic-affected Bengal Basin, Bangladesh and West Bengal (India)

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In the Bengal Basin, groundwater supplies drinking water to >100 million people and irrigates the most important food crop, with irrigation accounting for 90% of groundwater abstraction. The region suffers the world's worst case of arsenic pollution, where >20 million people still drink water containing >50 ppb As, predominantly from shallow aquifers. Moreover, As is accumulating in the food chain and; in some areas, contributing to similar levels of exposure and declining yield in rice. The use of groundwater is also constrained by salinity, iron, manganese, boron, barium, and microorganisms. Each constraint generates complex feedback mechanisms that further threaten the presently safe aquifers, most of which, for various social and economic reasons, will resulting in increased abstraction from deeper aquifers that are, at best, partly renewable resources. Based on population projections, estimates of annual potential recharge are sufficient to satisfy projected demand, but without intervention water quality constraints may make this impossible.

Arsenic in shallow aquifers is being redistributed, polluting safe wells, but also being attenuated, such that As concentrations are simultaneously increasing and decreasing in different parts of the aquifers. The greatest threats to the sustainable use of deep aquifers come from the lateral and vertical migration of arsenic and of residual salinity, plus excessive drawdowns. As shallow groundwater is drawn into deeper aquifers, natural attenuation will contribute to the gradual clean-up of the shallow aquifers. However, there is significant doubt whether the present abstraction scenarios are sustainable. Nonetheless, sustainability, or at least greatly increased resource life may be achieved through managed natural attenuation of As; artificial recharge in urban and rural areas; river bank infiltration; *in situ* removal of As, Fe and Mn; reduced distribution losses from piped water supplies from deep aquifers; and changes in agronomic practices and cropping patterns.

Geochemistry of granitoids of the Kerala Khondalite Belt, Southern India – Magmatic petrogenesis in an arc-accretion setting

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The Kerala Khondalite Belt (KKB) is an important lower crustal segment of the southern Indian granulite terrain. Most studies consider KKB to be of supracrustal origin. Tectonomagmatic framework is not well-constrained due to lack of comprehensive datasets for the entire KKB. In this study we bridge this gap by interpreting major- and trace-element data and REE systematic on major (> 70%) granitoid lithounit of the belt as related to the magmatic petrogenesis in an arc-accretion setting.

The granitoids of KKB can be classified as sodic and potassic groups based on K_2O/Na_2O ratios. The sodic group has geochemical affinity to Archaean tonalities with low-K, calc-alkaline, metaluminous to peraluminous chemistry. Compositionally contrasting K-rich rocks are essentially of granitic composition. Most oxides in both the groups, with exceptions of K_2O and Na_2O, show negative correlation with SiO_2. The sodic group is enriched in Sr and depleted in Rb and Th. They exhibit geochemical features similar to those of Archaean tonalite and trondhjemite [1] with enriched LREE and depleted HREE with positive and/or no Eu anomaly. On the other hand, potassic group show enrichment in large ion lithophile elements in relation to the high field strength elements and sharp negative anomalies of Eu, Nb, Sr, Zr, and Ti with fractionated REE patterns, implying significant fractionation of plagioclase into the residue and strong effects of intracrustal differentiation [2]. Complimentary patterns of Eu and Sr anomalies in both groups, also suggest an event of intracrustal magmatic differentiation in the presence of plagioclase. The most plausible tectonic model that explains the generation of sodic group is through melting of hydrous basaltic material at the base of a thick crust and that of potassic granites by partial melting of meta-igneous source rocks [3]. We speculate subduction zone related arc accretion setting followed by intracrustal melting for the evolution of KKB, which may therefore represent the deep-section of a collisional orogen.

[1] Taylor & McLennan (1995) *Rev. Geophys.* **33,** 241-265. [2] Gromet & Silver (1987) *J. Petrol.* **28,** 75-125. [3] Patiño Douce (1999) *Geol. Soc. London, Spec. Publ.* **168,** 55-75.