Field scale investigation of geochemical parameters controlling high and low As occurrence in Murshidabad District, West Bengal: India

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The assessment of incidence of arsenic (As) and the other major ions is evaluated in the groundwaters of Murshidabad, West Bengal. This work is executed over an area of about ~497 km^2. Water samples were collected from 39 hand pumped tube wells (~90-110ft), 9 ponds and 6 irrigation wells (~60-80ft) along with 4 sediment cores (~150ft) from these sites. Field sites are located east and west of the river Bhagirathi, a tributary of the river Ganges, flowing N-S through Murshidabad. The western part of Bhagirathi river is mainly occupied by Suja formation, older alluvium of Pleistocene age (oxidized ferruginous sand, silt and clay with caliche), whereas the eastern part of the river is occupied by Bhagirathi Ganga formation, newer alluvium of Holocene age (sand, silt and clay).

Comparative study of major water quality parameters reveal high As (10->500ppb) and low Mn (0.1-1.6ppm) in the areas like Beldanga, Hariharpara (east bank of the river) while low As (0-30ppb) and higher Mn (0.2-8ppm) is found in Nabagram, Kandi (west bank of the river). DO, NO_3^- and NH_3 do not show appreciable variation among the high and low As areas and they range from 1.5-5ppm, 0-2.7ppm and 0-0.06ppm respectively. TDS and conductivity do not show considerable variation among the high and low As areas and range from 0.001-6.2g/l and 2.6-988 µS/cm respectively. High As areas show a pH of 4.5-7.8 while pH in the low As areas is 5.1-8.2. Alkalinity values range from 10-18 mg/l at high and 10-180mg/l at low As areas. PO_4^{3-} values of high As areas range 0.2-11ppm and at low As areas the range is 0.3-1.3ppm. Cl^- values are higher at low As areas (40-148ppm) and lower at high As areas (10-60ppm). Fe^{2+} values at high and low As areas are 0.05-6ppm and 0.1-1.4ppm respectively. Analyses show positive correlation of arsenic with Fe^{2+}, PO_4^{3-} and TDS content in most of the high As areas, whereas the Mn and Cl^- ions are negatively correlated with high As in most areas. During field work it is observed that there is good correlation between tube well platform color and high As concentration areas which agrees with a recent study near Chakdaha, south of Murshidabad [2]. Stable isotope data from our sites show that groundwaters of this region are directly recharged by local precipitation without significant evaporation [3]. Organic matter within aquifer sediments drive dissimilatory iron reduction reaction and thus release As to the ground water [3].

[1] McArthur *et al*. (2012) *ES&T* **46**, 669-676. [2] Biswas *et al.* (2012) *ES&T* **46**, 434-440. [3] Datta *et al.* (2011) *Geophys. Res. Lett.*, 38, L20404, doi: 10.1029/2011GL049301.

The effect of Li on pegmatitic textures – experimental results

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Introduction

According to the most prevalent models that explain the genesis of pegmatites, crystallization takes place after appreciable liquidus undercooling in a medium rich in fluxing components, such as H_2O, B, F and P [1, 2, 3]. The present study examines the potential of Li as another fluxing agent and its effect on the formation of pegmatites.

Pegmatitic textures are developed in experimental samples that contain a starting material of common granitic composition, but enriched in Li_2O, 3% seed crystals of K-feldspar, albite and quartz, and varying amounts of H_2O. The experimental procedure involves initially heating the samples in a piston-cylinder apparatus to 1000˚C and 550 MPa for 1 hr, followed by cooling at 50˚C/min to temperatures from 600 to 900˚C and 500 MPa and keeping those conditions constant for 100 hrs.

The results show the formation of graphic intergrowths between quartz and K-feldspar that closely resemble the ones encountered in pegmatites. Additionally, numerous K-feldspar crystals exhibiting spherulitic and skeletal morphologies are formed in the experimental samples, suggesting rapid growth rates for the crystals that grow in the Li-enriched medium. The growth rates measured for the K-feldspar in the samples range from approximately 5 x 10^{-11} m s^{-1} to 2 x 10^{-9} m s^{-1}. Experiments conducted under the same conditions but with Li-free starting material do not exhibit the same tendency.

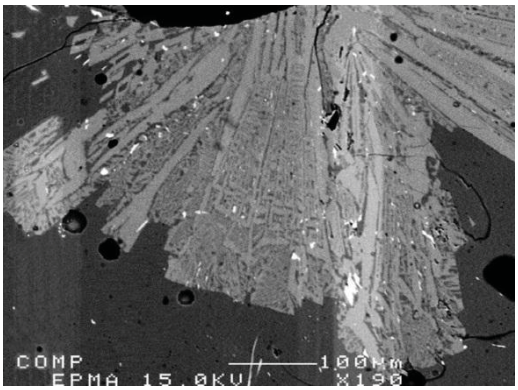

Figure 1: Graphic intergrowth between K-feldspar and quartz developed experimentally (2% added Li_2O, 12% added H_2O, P=500 MPa, T= 600˚C, t=100 hrs)

Conclusion

The experimental results indicate that the presence of Li in the system promotes the fast growth of crystals as well as the development of graphic quartz-feldspar intergrowths, both typical characteristics of pegmatites.

[1] Fenn (1986) *American Mineralogist* **71**, 325-33. [2] Jahns & Burnham (1969) *Economic Geology* **64**, 843-864. [3] London (2008) Pegmatites, 347p.