# Arsenic mitigation and safe water provisions in sedimentary basins of Northern China: Utilization of deep aquifer and piped water system

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An estimated 3 million people were exposed > 0.05 mg/L As in drinking water in wells tapping shallow aquifers of Songneng, Hetao, Datong, Yinchuan and Kuitun Basins in northern China. The China Geological Survey conducted a series of investigations using remote sensing, geophysical, geochemical and hydrogeological surveys aimed to identify safe aquifers for drinking water supply.

These low lying basins in arid or semi-arid climatic zones show similar hydrodynamics with sluggish flow down the flow path. Arsenic content in groundwater increases < 1 μg/L from the advancing edge of the piedmont sloping plain to as much as 1820 μg/L towards the center of plains. Although there is a large degree of spatial variation of arsenic content, high arsenic is usually found between 10m and 80m in a lacustrine sedimentary facies consisted of organic-rich, muddy, and silty fine sand. Low arsenic groundwater is found at depth below the arsenic containing shallow groundwater in confined aquifers, and also in shallow phreatic water in ancient channels and the sides of diversion canals. To avoid over exploration of low arsenic deep groundwater, the well spacing of production wells were designed considering well depth, diameter, pumping horizon, groundwater production. Corrosion resistant U-PVC pipes were used and the wells sealed to prevent shallow groundwater intrusion.

The aquifer with low arsenic groundwater in piedmont alluvial sloping plain is characterized by coarse grain size with high yield. In areas where no deep groundwater production wells can be drilled, this aquifer was developed and piped water systems built.

Our experience demonstrates that sustainable development of low arsenic aquifers can be achieved.

# Hyperspectral mapping of mineral assemblages using spectral unmixing

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Hyperspectral remote sensing offers mineral exploration ability to map efficiently the distribution of various mineral assemblages [1]. The Pulang area, which is an important polymetallic enrichment zone in Yunnan Province in southwest China, is used as a case study. Access into this high altitude mountainous area is difficult and the ability to map indications of mineralization using spectral remote sensing is desirable.

This study used EO-1 Hyperion remote sensing data. The hyperspectral image was first atmospherically corrected using the FLAASH model. Field spectra of typical mineral assemblage samples were measured *in situ* using the ASD FieldSpec 3 spectroradiometer. Background field spectra were acquired in large homogeneous areas. All field measurements were repeated 50 times and the mean spectra were computed as endmembers. It was assumed that the image spectra are linear combinations of endmember spectra. Then, the constrained Linear Spectral Unmixing algorithm was applied to the Hyperion data and abundances of mineral assemblages were obtained to generate a map of mineral assemblages. The results indicate that different mineral assemblages, particularly those associated with the polymetallic zone, can be identified successfully and they also partially coincide with soil geochemical anomalies. Future work would involve evaluation of abundances of mineral assemblages.

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[1] Bierwirth *et al*. (2002) *Economic Geology* **97**, 819–826.