

## ARSENIC IN GHANA, WEST AFRICA, GROUND WATERS

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Ghana, the former Gold Coast, is richly mineralized with gold that is accompanied by arsenic mineralization. The Upper Birimian formation has over 10 times the average crustal abundances of Au and As. Our working hypothesis was that groundwater in the 10 belts of Au mineralization and Upper Birimian rocks that cross Ghana have elevated As concentrations.

Arsenic and water chemistry were analyzed in all rural hand-dug wells and boreholes in a 6500 sq. km area of SW Ghana. In addition arsenic was measured in several wells at and near gold mines. Arsenic was analyzed in the field with an Arsenator™ that has a detection limit of 0.5 ppb, and the results validated by GFAA analyses. Speciation was done on selected wells. Skin problems in villagers similar to those associated with arsenic poisoning were noted.

Arsenic was detected in 52 of 207 wells studied. Concentrations range up to 2000 ppb and 25 wells have arsenic > 5 ppb (Table 1). In some wells arsenic concentrations vary daily by more than a factor of 2. High arsenic waters are associated with Upper Birimian rock, gold-arsenic mineralization, borehole wells, and low-Eh, high-TDS waters. Speciation shows significant concentrations of As(+3). A strong correlation was found between skin problems and arsenic concentrations in well waters (Table 2). Hand dug wells have less arsenic than bore hole wells, but much more nitrate, and there is correlation between well depth and arsenic concentration. Column experiments show that Ghana laterite strongly sorbs arsenic. There is no correlation between sulfate and arsenic although the arsenic source most probably was sulfide mineralization,. High-arsenic wells are commonly less than 100 m from wells that have trace amounts indicating that arsenic mobility is limited and there is little communication between water-bearing fractures.

We conclude that at least 10% of Ghana's rural borehole water wells have arsenic greater than WHO standards. Our data indicates deeper, more evolved waters are charged with arsenic and suggests that local recharge by near-surface nitrate-rich waters reduces groundwater arsenic concentrations during the rainy season. Borehole water arsenic-concentrations are expected be higher during the dry season. Evidence for arsenic-related skin problems is explained by ingestion of arsenic-bearing soils together with high consumption of water in the tropics.

Field work was conducted in part by K-12 science teachers support by Fluorite-Hays and Conrad Hilton Foundation grants.

Table 1. Summary of Ghana well analyses

Concentration	Bore Holes (No. of wells)	Hand Dug Wells (No. of wells)
As > 5 ppb	23	2
As 0.5 to 5 ppb	30	6
As < 0.5 ppb	74	68
Fe > 0.5 ppm	52	15
NO <sub>3</sub> > 10 ppm	26	50

Table 2. Summary of noted skin problems in SW Ghana similar those associated with arsenic poisoning.

As (ppb)	Wells for which health affects noted in at least one person	Total Wells	% of wells with noted health affects
2 - 120	14	27	52 %
0.5 to 2	4	22	18 %
< 0.5	6	153	4 %