

Arsenic in Fairbanks area groundwater: krieged distribution versus reality

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Fairbanks groundwaters naturally contain significant As; many wells in the area possess As >> than the EPA recommended levels of 50 parts per billion (ppb). With hundreds of wells in the greater Fairbanks area containing <1 to >5000 ppb As, it is difficult to depict the overall patterns. Weber (1986) compiled the available data and then used the geostatistical technique ‘krieging’ to estimate Arsenic contours for Fairbanks area groundwater. As no compiled Fairbanks groundwater As map exists, the krieged As value map has been widely disseminated by UAF Cooperative Extension Service (HCM-04954, 1989, revised 1998) as a guide for local residents in estimating likelihood for high As well waters. Casual comparison of the krieged map to As values from USGS reports, however, suggested there were problems with the former. Because the data used by Weber (1986) were not adequately archived, no compiled data set exists. To quantitatively test the krieged map, I had to relocate, digitize, and re-compile data from a multitude of original sources.

After several years of effort, I have Arsenic data and locations for ~600 wells in the Fairbanks area, with location errors of \pm 10-50 m. As anticipated, the distribution of As shows serious discrepancies with the krieged map. In particular, all (29) wells with As > 500 ppb fall outside of the >500 ppb As krieged map contours; many are in areas show as containing ‘safe’ (<50 ppb As) water. Most of the 121 wells with > 50 ppb As plot in areas on the krieged map as containing <50 ppb As. Conversely, large areas of the krieged As map are (incorrectly) shown as containing high As water due to the influence of localized, isolated high As wells. I attribute these problems to difficulty in accurately locating wells from the progressive quartering method employed by the USGS, to primitive GIS systems available at UAF in the early 1980s, and to the nature of the krieging process.

The krieged As map also fails to show up the most dramatic aspect of Fairbanks As distribution: rather than stratigraphic control on high As (suggested by Weber, 1986), high As is spatially associated with high angle, NE-trending faults in a band encompassing Ester Dome-Farmer’s Loop-Chena Hot Springs Road. Wells near Ester Dome display high As where located on high-angle faults that host major gold-arsenopyrite-quartz vein deposits (e.g., the Ryan Lode) or down the hydrostatic gradient from such deposits. High-As groundwater moves several km down-gradient from these veins and is likely responsible for high As wells in Sheep Creek valley. Geochemical modeling shows As (and Fe) solubility with pyrite maximized if magnetite-goethite present; this water can carry As without precipitation in the subsurface.

Fairbanks area Au-As quartz veins are associated with Cretaceous granites and such a granite was intercepted by deep drilling in the Yankovich road area. I propose that the high As wells of the Yankovitch-Pearl Creek area are sit above deeply buried gold deposits.