

SUMMARY AND CONCLUSIONS

Arsenic concentrations in public-supply wells in the New England Coastal Basins at or above 0.005 mg/L were detected in more samples of water from wells completed in bedrock (25 percent of all samples) than in water from wells completed in stratified drift (7.5 percent of all samples). Iron and manganese were detected (at concentrations of 0.05 mg/L and 0.03 mg/L, respectively) at approximately the same frequency in water from wells in both types of aquifers.

The concentration of arsenic in bedrock public-supply wells has been evaluated relative to lithochemical data generalized from state bedrock geologic maps in the New England Coastal Basins study unit. Arsenic concentrations were significantly higher in water from wells in the metasedimentary rock group M_c than in five other groups of rocks in the study unit. Arsenic was detected, at concentrations of 0.005 mg/L or above, in ground water from 44 percent of the wells in group M_c and less than 28 percent in the other 5 groups. Additionally, arsenic concentrations were the lowest in the metasedimentary group M_s .

Arsenic concentrations in bedrock wells also correlate with land use; significantly higher concentrations are found in areas identified as agricultural land use than in undeveloped and urban land uses. The attained significance level for the land-use relation ($p = 0.0123$), however, is lower than for the geologic relation ($p = 0.0001$). Additionally, geologic and land-use data appear to be correlated to one another; specifically, there is more agricultural land use in the metasedimentary groups M_c and M_{md} than in other lithochemical groups. Relations between arsenic concentrations and lithochemical groups of bedrock units remained the same when arsenic data associated with agricultural land were removed from the analysis. However, the relations between arsenic concentration and agricultural land use were weakened when arsenic data from group M_c were removed.

The correlation of arsenic in bedrock ground water could be the result of various factors including (1) arsenic in soils and rocks that are part of the ground-water-flow system, (2) solubility and transport controls of arsenic in ground water, (3) vulnerability of ground-water supplies to surface contamination, and (4) the spatial associations between land use, geology, and ground-water-flow patterns. Two possible general sources for arsenic in ground water in New England

are (1) natural geologic sources, including arsenic-containing sulfide minerals, or arsenic contained in trace amounts in other minerals present in rocks, and (2) anthropogenic sources, primarily considered to be from past (early 1900's to the 1960's) arsenical-pesticide usage.

The presence of arsenic in water from wells in bedrock aquifers, and the variation of these arsenic concentrations in wells in major lithochemical groups and in some bedrock units indicates a bedrock source is probable for at least some of the arsenic in the water. Anthropogenic sources could also be contributing to the concentrations of arsenic in ground water; however, the relative importance and interrelation of the anthropogenic and geologic sources is unclear. Few whole-rock geochemical data exist for the rock types in the lithochemical groups where elevated arsenic concentrations are present in ground water. The few available whole-rock and ground-water analyses from northern Massachusetts, central New Hampshire, and in southern Maine, indicate that, at least locally, a spatial connection between bedrock chemistry and concentrations of arsenic in ground water. Without additional data, however, the quantitative effect of the specific bedrock types on arsenic concentrations in ground water cannot be determined. The interdependence of lithochemical group and land-use indicates that additional data are needed to explain the cause of the arsenic concentrations in ground water. If ground-water flow over time has resulted in the movement of ground water with measurable arsenic from agricultural land use to other land-use types, this could also account for the lack of a strong relation between land use and arsenic. The low levels of arsenic in the metasedimentary group M_s indicate that the arsenic in bedrock ground water cannot be explained by simple dissolution of arsenic-bearing iron sulfides.

The anomalous ground-water arsenic detections in water wells from a few, small, bedrock units highlight some exceptions to the regional-scale generalizations presented in this report. More detailed examination of these anomalies, using additional water-quality data for wells in the current data set, and data from domestic wells, could improve the resolution of the model and the understanding of what controls sources and solubility of arsenic.

The statistical relations determined for arsenic concentration and lithochemochemistry are reasonably strong, but interpretation of the results is limited by the nature of the data set. Current data do not allow the cause of arsenic in ground water to be determined, nor is it possible to predict the occurrence and distribution of arsenic in ground water. By using data from public water-supply wells, non-potable ground waters (with high dissolved solid loads or with water that does not meet regulatory standards) that could differ with respect to spatial and chemical association

patterns from the potable ground waters in the region were not included in the analysis. The relation of arsenic concentration to lithochemochemical groups, using this data set, does, however, provide an important beginning to understanding arsenic source and solubility controls. Geochemical data from rocks, more complete water-quality data, time-line studies of arsenic concentrations, and site-specific studies, will be critical in determining the source of, and controls on, arsenic in ground water.