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**Title: USING ALLUVIAL BASIN GROUNDWATER CHEMISTRY TO STUDY DISPERSION FROM PORPHYRY COPPER DEPOSITS IN ARIZONA**

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**Author 1 (CONTACT AUTHOR)**

Name: Karen Bolm

Org: U.S. Geological Survey

Country: USA

**Author 2**

Name: Timothy Hayes

Org: U.S. Geological Survey

Country: USA

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Abstract: In basin-and-range Arizona, groundwater chemistry can be used to 1) explore for concealed deposits, and 2) map the environmental fate of contaminants from existing mines. Groundwater chemical data were compiled from USGS Water Resources Discipline (WRD) databases and Arizona Department of Environmental Quality (ADEQ) mine area aquifer protection studies. WRD wells with analyzed water were selected using ArcGIS. Wells started in Oligocene to Holocene sediments and volcanics and in Laramide and Jurassic intrusives were selected using formation contacts from the digital state geologic map. The ADEQ data completed some anomaly patterns on upgradient ends and were used to compare mine-affected dispersion patterns with natural patterns.

Mined areas have the same anomaly arrangement that undisturbed mineralized areas have. Mine-affected concentrations of sulfate ( $\text{SO}_4$ ) and metals are higher, at places, but rarely by an order of magnitude. From up-slope of the Cu deposits towards basin centers, the general pattern is: 1) dilute Ca-bicarbonate( $\text{HCO}_3$ )-type water with pH near 7, with high dissolved oxygen (DO), and with low trace metals, 2) near-deposit Ca- $\text{SO}_4$ -type water commonly with low pH, low DO, high  $\text{SO}_4$ , and high Cu, Mn, Zn, and Fe, 3) near-downgradient, Ca- $\text{SO}_4$ - $\text{HCO}_3$ -type water with moderate pH, moderate-to-high DO, high  $\text{SO}_4$ , high Mo, and locally high Zn, and 4) ordinary basin groundwater, typically Ca-Mg- $\text{HCO}_3$ -type with increasing pH, Na, K,  $\text{SO}_4$ , and Cl and decreasing DO towards basin low points. Near-deposit pH, Cu, and  $\text{SO}_4$  anomalies are from oxidation of sulfides, well known from supergene enrichment studies. Less known is that dissolving sulfides to  $\text{SO}_4$  strips oxygen from the water, leaving it with low DO. Fe and Mn are appreciably soluble only in low DO water. Also less known is that Mo is adsorbed at low pH but soluble at high pH. Mo reaches anomalous concentration where pH is high in contact with carbonates and feldspars, typically farther from deposit sources than other metals,

traceable for 11 km below pre-development Mission-Pima.  $\text{SO}_4$  is the other anomaly that can extend far from source deposits, possibly up to 17 km from post-mining Mineral Park. Unreplaced calcite causes patterns below skarns to start at 3), then evolve downgradient to 4). Deposits lacking sericitic and argillic alteration produce only minor pH anomalies, yet still yield  $\text{SO}_4$ , DO, Cu, Zn, and/or Mo anomalies.

Using this and no other data and relating to known covered deposits, Santa Cruz and Poston Butte areas would have been noted as anomalous. Neither Sol nor San Rafael areas would have, because there are no nearby data. And, near closely spaced Superior East and Resolution, it is not clear which deposit(s) sourced the anomalies.

There are areas that have combinations of anomalous values remote from any known deposit or prospect. Geologic interpretation is still required. For example, near basin centers, high  $\text{SO}_4$  values caused by gypsum beds occur.