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Preliminary distribution of molybdenum in heavy-mineral concentrates, Richfield 1° x 2° quadrangle, Utah

by

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This report is preliminary and has not been edited or reviewed for conformity with U.S. Geological Survey standards.

INTRODUCTION

The purpose of these maps is to provide the regional geochemical framework for the U.S. Geological Survey's Conterminous United States Mineral Assessment Program (CUSMAP) for the Richfield 1° x 2° quadrangle. The regional sampling is designed to provide definition of broad geochemical patterns and trends which can be utilized along with geologic and geophysical data for the assessment of the mineral resource potential for this quadrangle. These maps show the regional distributions of molybdenum in two fractions of heavy-mineral concentrates of drainage sediments for the Richfield 1° x 2° quadrangle.

COLLECTION OF SAMPLES

Drainage sediment samples were collected throughout the Richfield quadrangle during summer, 1978. The sample sites were located along small normally unbranched or first-order stream drainages which range 1.7-3.3 km (1-2 mi) in length. Sample density was 1 sample per 8 km^2 (1 sample/ 3 mi^2) within the bedrock areas. Basins containing unconsolidated or semiconsolidated sediments were not sampled. Samples were composited by collecting a sample at four or five sites across and along the active channel. The geochemical sampling was carried out by W. R. Miller, J. B. McHugh, G. K. Lee, J. F. Guadagnoli, L. DiGuardia, J. D. Tucker, and R. E. Tucker.

PREPARATION OF SAMPLES

Samples of drainage sediments were first panned to reduce the amount of common rock forming minerals such as quartz and feldspar. Most of the drainages were dry so the samples were panned at a field laboratory. About half of the panned (heavy mineral) concentrates were prepared and analyzed at the mobile field laboratory and the remaining were prepared and analyzed at the U.S. Geological Survey laboratory in Golden, Colorado. The preparation and analyses were done by J. M. Motooka, J. B. McHugh, J. D. Tucker, R. E. Tucker, and J. F. Guadagnoli.

The panned concentrates from each sample were dried and sieved to minus-18-mesh (<1.00 mm), and the magnetite was removed with a hand magnet. The remaining concentrate was separated at a specific gravity of 2.86 with bromoform into a light and a heavy fraction. The light fraction, which contained mainly minerals such as quartz, feldspar, and calcite was discarded. The heavy-mineral fraction was separated electromagnetically by a Frantz[1] isodynamic separator with forward and side angle setting of 15 degrees and an ampere setting of 0.2. The magnetic fraction at 0.2 amperes was discarded and the nonmagnetic fraction was further separated electromagnetically into nonmagnetic and magnetic fractions at a setting of 0.6 amperes. These two fractions were then analyzed.

[1] Use of brand names in this report is for descriptive purposes only and does not constitute endorsement by the U.S. Geological Survey.

ANALYTICAL PROCEDURES

Each fraction was analyzed semiquantitatively for 30 elements by a 6-step D.C. arc optical emission spectrographic method (Grimes and Marranzino, 1968). The results of the analyses can be found in Motooka and others (1979). All values are reported as six steps per order of magnitude (1, 0.7, 0.5, 0.3, 0.2, 0.15, or multiples of 10 of these numbers) and are approximate geometric midpoints of the concentration ranges. The precision is shown to be within one adjoining reporting interval on each side of the reported value 83 percent of the time and within 2 adjoining intervals 96 percent of the time (Motooka and Grimes, 1976).

GENERATION OF MAPS

Computer-generated contour maps and point plot maps for each fraction of heavy-mineral concentrates were prepared using the U.S. Geological Survey's computer program-STPMAP, written by J. Kork and modified by G. VanTrump. The program calculates an average value within a square cell to generate the contours. For these plots, the Richfield quadrangle was divided into 35 cells (5 km on a side) in the east-west or X-direction. The contours show regional distributions but do not show exact locations of exploration targets. In places, (for example the extreme southwestern corner of the map plot for molybdenum in the nonmagnetic fraction) the use of an average value of a cell gives misleading information. In this case, one high value for Mo, at the margin of the mountain range, causes the anomaly to be extended into the basin where samples were not collected. However, the accompanying point plots indicate the location and magnitude of anomalous values, in addition to the location of all the sample sites, which permits the validity of each anomaly on the contour plots to be evaluated. For the point-plot maps, approximately 10 percent of the total number of samples are classified as anomalous. These samples were divided into five classes ranging from weakly anomalous to strongly anomalous.

GEOCHEMICAL IMPLICATIONS OF THE MAGNETIC AND NONMAGNETIC FRACTIONS

The nonmagnetic and magnetic fractions consist of different heavy mineral suites, whose geochemical implications, with regard to potential mineral resources differ significantly. The nonmagnetic fraction contains accessory rock minerals such as zircon and apatite and most primary and secondary ore minerals. Anomalous trace metal concentrations in this fraction generally indicate surface or near surface sources. The magnetic fraction contains mafic rock minerals (biotite, amphibole, and pyroxene) and more importantly, both detrital and hydromorphic Fe and Mn oxides containing anomalous trace metals. Fe and Mn oxides commonly fill or coat fractures and are abundant along faults. Anomalous trace metal content of the magnetic fraction could therefore indicate possible buried deposits. The use of both fractions aid in the interpretation of geochemical data and provide clues to the geological environment and the source of anomalous metals. It should be emphasized that these methods do not pick up a major discovery of molybdenum at Pine Grove (Lamerdorf Peak 7 1/2-minute quadrangle) in the southern Wah Wah Range, now being explored by industry. Whereas reconnaissance geochemical surveys are valuable tools in mineral exploration, they are not complete tools and should be used in conjunction with data from other earth science disciplines.

DISCUSSION OF ANOMALIES

Magnetic Fraction

Barn Hills Anomaly

This anomaly is centered within the Barn Hills but also includes a few high values in the Confusion Range on the west and the House Range on the east. The anomalous values are from areas underlain by Ordovician Fish Haven Dolomite, Silurian Laketown Dolomite, and Devonian Sevy Dolomite. Mn and Fe oxides occur as coatings and fillings along fractures and faults, and as coatings within cherty layers within the dolomites. The anomalous Mo values are probably contained within these oxides and may represent possible mineral occurrences at depth.

Whereas the geochemical Mo anomaly in the Barn Hills may suggest a possible buried intrusive source, no evidence was seen in available aeromagnetic data (Mabey and Virgin, 1980) to support this suggestion.

Burbank Hills-Tunnel Spring-Northern Needles Range Anomaly

This anomaly includes the Burbank Hills, Tunnel Springs Mountains, and northern Needles Range. The anomalous areas are underlain by Paleozoic sedimentary rocks and Tertiary volcanic rocks. The Paleozoic units include Devonian Sevy Dolomite, Mississippian Joana Limestone and Chainman Shale, Mississippian and Pennsylvanian Ely Limestone, limestone, dolomite, sandstone, and gypsum of the Permian Arcturus Formation, and limestone of the Riepe Spring Formation of Steele (1960). The Tertiary volcanics are mainly quartz latitic ash-flow tuffs of the Needles Range Formation. The anomalous values occur over a variety of rocks and ages and many occur along or near faults. The anomalous molybdenum values may be associated with Fe and Mn oxides which occur as coatings and fillings along fractures and faults similar to those in the Barn Hills anomaly. Whether hidden intrusive sources for the Mo exist at depth cannot be determined from presently available data.

Wah Wah Mountains Anomaly

This anomaly can be separated into two parts which occur along each flank of the Wah Wah Mountains. The eastern anomaly is mainly within the Blue Mountains 7 1/2-minute quadrangle north of Jockey Road. This area is underlain largely by Cambrian limestones, minor shale, and dolomite and Triassic (?) and Jurassic Navajo Sandstone, but also by Tertiary volcanics including Miocene rhyolite and associated altered and mineralized rock.

The western anomaly is in the Tetons 7 1/2-minute quadrangle north of Jockey Road. This area is underlain by Paleozoic sedimentary rocks, chiefly carbonates, but is near Miocene rhyolite centers with associated fluorite-uranium deposits and anomalous Sn, Mo, and Be (Lindsay and Osmonson, 1978).

Indian Peak Range and Southern Wah Wah Mountains Anomaly

This anomaly is separated into two parts by Pine Valley but the two areas may be connected beneath the valley fill. The anomalous area west of the Pine Valley Road occurs mainly within the Bible Spring and Steamboat Mountain 7 1/2-minute quadrangles within the Indian Peak Range. It is underlain by locally altered Tertiary rhyolites.

The anomaly east of the Pine Valley Road occurs mainly in the Mountain Spring Peak 7 1/2-minute quadrangle within the southern Wah Wah Mountains. It is underlain, in large part, by Tertiary rhyolite (Best, 1979).

Star Range-Beaver Lake Mountains-Rocky Range-Southern Mineral Mountain Anomalies

These anomalous areas are underlain mainly by Paleozoic sedimentary rocks near Tertiary granite or granodiorite intrusives. They are associated with old mining districts and are probably contaminated by past mining activities. The possibility exists that a porphyry-molybdenum type deposit may underlie the Star Range anomaly, but the data is insufficient for this determination.

Tushar Mountains Anomalies

Several anomalies are present within the central Tushar Mountains especially within or near the Mount Belknap caldera (Beaver and Delano Peak 15-minute quadrangle). The anomalous areas in Upper Indian Creek and upper North Fork of North Creek are underlain largely by Mount Baldy Rhyolite Member of the Miocene Mount Belknap Volcanics (Cunningham and Steven, 1978). The anomalous area in upper Beaver Creek and near Blue Lake (Delano Peak 15-minute quadrangle) is underlain by the middle tuff member, Blue Lake Rhyolite Member, and lower tuff member of the Miocene Mount Belknap Volcanics (Cunningham and Steven, 1978). In addition, most of these areas are above the southern or eastern ring-fracture zone of the Mount Belknap caldera where Cunningham and Steven (1979c) have postulated possible hidden intrusives and associated molybdenum-uranium occurrences.

Southwestern Pavant Range Anomaly

The anomalous area occurs along the west fork of Dry Wash and west of Widemouth canyon within the northeastern corner of Cove Fort and northwestern corner of Sevier 15-minute quadrangles. The area is underlain by thrust-faulted Paleozoic and Mesozoic sedimentary rocks. In certain aspects, it is similar to the Barn and Burbank Hills in that there is no clearly apparent associated igneous activity.

South Twin Peak Anomaly

The magnetic fraction from one sample taken at the Quaternary rhyolite flow-dome of South Twin Peak contained anomalous Mo. The anomaly is probably associated with a flow breccia which appears to have been altered and Fe-stained after its formation.

Nonmagnetic Fraction

Molybdenum content is generally lower than in the magnetic fraction. High values in the nonmagnetic fraction probably reflect molybdenite in the sample. The known mining districts are identified by this fraction but the additional anomalies probably reflect near surface mineralization.

Southern Needle Range and Southern Wah Wah Mountain Anomaly

This anomaly occurs mainly in the Steamboat Mountain, Bible Spring, and Mounain Spring Peak 7 1/2-minute quadrangles. The anomalous values are from areas underlain by Tertiary volcanic rocks which include significant quantities of Miocene rhyolites. There has been some past mining activity but contamination from mining probably is not a major problem. This area was also anomalous for molybdenum in the magnetic fraction of heavy mineral concentrates.

Star Range Southern San Francisco Mountains-Rocky Range and Beaver Lake Mountains Anomalies

These anomalies occur in areas underlain by Paleozoic sedimentary rocks, often in close association with Tertiary quartz monzonite or granodiorite intrusives. They are probably related to known mineral deposits in established mining districts and are contaminated by past mining activity.

Mineral Mountains Anomaly

Several anomalies occur within the Mineral Mountains. The southern anomaly occurs in areas underlain by Paleozoic sedimentary rocks, in close proximity to granitic rocks. The anomaly is probably related to known mineral deposits and may be contaminated by past mining activity.

The anomalies in the central and northern Mineral Mountains are generally not related to known mineralization. They occur mainly in areas underlain by granitic rocks of the Mineral Mountains batholith, although some are near Quaternary rhyolite centers (Lipman and others, 1978).

Tushar Mountains Anomalies

Several anomalies occur within the central Tushar Mountains in an area known to have been mineralized at several times in late Cenozoic time (Steven and others, 1979). The anomaly with the highest value occurs along a north tributary of Cottonwood Creek (Delano Peak 15-minute quadrangle) south of Deer Trail Mountain. The area is underlain by sandstones, siltstones, and shales of the Triassic Moenkopi Formation and Triassic (?) and Jurassic Navajo Sandstone (Cunningham and Steven, 1979a). Other anomalous areas along the eastern side of the Tushar Mountains include : (1) upper Revenue Gulch (Delano Peak 15-minute quadrangle) which is underlain by intermediate volcanic rocks of the Oligocene and Miocene Bullion Canyon Volcanics (Cunningham and Steven, 1979b); (2) a tributary of upper Beaver Creek which is underlain by intracaldera rhyolite flow and ash-flow tuffs of the Miocene Mount Belknap Volcanics (Cunningham and Steven, 1978); (3) upper eastern tributary of Mill Creek (Delano Peak 15-minute quadrangle) which is underlain by quartz monzonite of the Bullion Canyon Volcanics and Joe Lott Tuff Member of the Mount Belknap Volcanics (Cunningham and Steven, 1978); and (4) Wilson Creek, a tributary of Fish Creek (Delano Peak 15-minute quadrangle) which is underlain by heterogeneous lava flows and breccias and quartz monzonite of the Bullion Canyon Volcanics.

Lesser anomalies along the western side of the Tushar Mountains occur along upper Indian Creek within the Mount Belknap caldera (Cunningham and Steven, 1978) and along the North Fork of North Creek (Beaver and Delano Peak 15-minute quadrangle) within and just outside the caldera.

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