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Distribution of molybdenum in heavy-mineral-concentrate samples from the Charlotte 1° x 2° quadrangle, North Carolina and South Carolina

by

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This map is a product of a geochemical survey of Charlotte 1° x 2° quadrangle, North Carolina and South Carolina, beginning in 1978 that is part of a multidisciplinary study to determine the mineral potential of the area. Correlative studies are the completion of a geologic map of the quadrangle and aeromagnetic, aeroradiation, and gravity surveys (Wilson and Daniels, 1980).

The Charlotte quadrangle provides a nearly complete section across the Piedmont: its northwestern corner is in the Blue Ridge, its southwestern corner is over a basin of Triassic sedimentary rocks only a few miles from the Coastal Plain. All of the quadrangle except the southeastern corner is underlain by crystalline rocks of Precambrian and Paleozoic age metamorphosed to greenschist facies in the Slate Belt and to amphibolite facies farther west. Both premetamorphic and post metamorphic intrusive rocks are present. The rocks have been weathered to permeable saprolite reaching depths of 200 feet (60 meters) in the Inner Piedmont. Because of the thorough leaching, most soils are acidic.

In making the geochemical survey, we took samples of sediment within a few miles of the heads of major streams and of the tributaries of these streams. By keeping the size of the drainage basin small, we usually reduce the variety of rocks that contribute detritus to the sample, thus facilitating a correlation between sample composition and the geology of the drainage basin. At the same time, we reduce the chance that a localized cloudburst has buried the sample site with sediment from a small part of the drainage basin, thus reducing the validity of the sample as an approximate composite of the rocks of the whole basin. Nevertheless, the samples are not all geologically and geochemically equivalent. For instance, at some sites in the mountainous area in the northwestern part of the quadrangle, many clasts in the stream sediment are several yards (meters) across and collection of fine detritus suitable for a sample required a 1/2-hour search. Not far to the east, the finer sediment was abundant. In the Piedmont, the usual procedure was to sample rather coarse sediment--pebble- or cobble-containing gravel--and to dig deeply to the bottom of the alluvial bed or to a compact clay layer. The coarsest particles in the gravel--boulders, cobbles, and coarse pebbles--were excluded from the sample, which then consisted of about 10 lbs (4 1/2 kg) of clay to granule or fine gravel sized material. The heavy minerals were extracted from this material at the sample site with a gold pan. The concentrates were passed through a 20-mesh sieve to remove large grains that would choke equipment used in subsequent laboratory operations. Samples taken in the same manner on earlier projects were also used to get better coverage of the Inner Piedmont than we would have had otherwise.

The quartz, feldspar, and other minerals of specific gravity below 2.89 were removed from the pan concentrate by floating them with bromoform. The heavy-mineral concentrate cleaned in that way was then separated magnetically into four fractions. The first was removed with a hand magnet, or an equivalent instrument, and not studied. The remaining concentrate was passed through a Frantz Isodynamic Separator at successive current settings of 0.5 ampere and 1 ampere with 15° side slope and 25° forward slope. The material removed from the sample at 0.5 ampere and 1 ampere will be referred to as the M.5 and M1 concentrates or fractions, respectively, and the nonmagnetic material at 1 ampere will be referred to as the NM concentrate or fraction. Most common ore minerals occur primarily in the NM fraction, making them and their contained metals easier to find and to identify. The NM fraction also contains zircon, sillimanite, kyanite, spinel, apatite, sphene, and the TiO_2 minerals. It is generally the most useful fraction. The M1 fraction is largely monazite in the Inner Piedmont. Because of interferences caused by cerium during spectrographic analysis and the high content of radiogenic lead in the monazite, it was necessary to remove it from the bulk concentrates. East of the Inner Piedmont the M1 concentrate contained very abundant epidote, clinozoisite, mixed mineral grains, including ilmenite partly converted to leucoxene, staurolite, and locally abundant spinel. The M.5 concentrate contains abundant garnet in the Inner Piedmont, dark ferromagnesian minerals in the Charlotte Belt, and ilmenite in most provinces.

Mineral proportions of each magnetic fraction were estimated using a binocular microscope. Minerals of special interest were identified optically or by X-ray diffraction.

Each fraction was analyzed semiquantitatively for 31 elements using a six-step, D.C. arc, optical-emission spectrographic method (Grimes and Marranzino, 1968). The semiquantitative spectrographic values are reported as one of six steps per order of magnitude (1, 0.7, 0.5, 0.3, 0.2, 0.15, and multiples of 10 of these numbers) and the values are the approximate geometric midpoints of the concentration ranges. The precision of the method has been shown to be within one adjoining reporting interval on each side of the reported values 83 percent of the time and within two adjoining intervals on each side of the reported value 96 percent of the time (Motooka and Grimes, 1976).

The lower limits of determination for the 31 elements that were determined spectrographically are as follows:

For those given in percent:

Calcium	0.1
Iron	0.1
Magnesium	0.05
Titanium	0.005

For those given in parts per million:

Antimony	200	Molybdenum	10
Arsenic	500	Nickel	10
Barium	50	Niobium	50
Beryllium	2	Scandium	10
Bismuth	20	Silver	1
Boron	20	Strontium	200
Cadmium	50	Thorium	200
Chromium	20	Tin	20
Cobalt	10	Tungsten	100
Copper	10	Vanadium	20
Gold	20	Yttrium	20
Lanthanum	50	Zinc	500
Lead	20	Zirconium	20
Manganese	20		

All analytical data for sample material other than concentrates are taken from reports by Heffner and Ferguson (1978) and Ferguson (1979). Such sample material is referred to as "silt" in this report.

Most samples were taken by J. W. Whitlow and W. R. Griffitts. Lesser numbers were taken by D. F. Siems, A. L. Meier, and K. A. Duttweiler. The mineral analyses were made by W. R. Griffitts, K. A. Duttweiler, J. W. Whitlow, and C. L. Bigelow, with special mineral determinations by T. Botinelly. All spectrographic analyses were made by D. F. Siems, in part from plates prepared by K. A. Duttweiler. Steve McDanal and Christine McDougal were responsible for entering and cleaning up the spectrographic data in the RASS computer file. Many maps were subsequently plotted from this file by H. V. Alminas, L. O. Wilch, and J. D. Hoffman. Most mineral distribution maps were plotted by K. A. Duttweiler.

Several trends are conspicuous in the maps showing distribution of molybdenum. The most prominent is a discontinuous band that crosses the quadrangle about from the southwestern corner to the northeastern corner, along which many concentrates contain detectable molybdenum. This band not only has abnormal numbers of molybdenum-rich concentrates but it separates the nearly barren northwestern part of the quadrangle from the well populated southeastern part. The paucity of molybdenum-bearing samples in the western part adds to the prominence of the cluster of samples associated with thrust faults and the Brown Mountain granite and Wilson Creek gneiss near the northwestern corner of the quadrangle.

Molybdenum was detected in NM fractions of samples taken near the Cherryville pluton, but not commonly in samples taken over the igneous rock mass itself (Plate 2). Several molybdenum-bearing concentrates were collected southwest of the terminus of the pluton. NM concentrates containing molybdenum were obtained over the Churchland pluton, near the northeastern corner of the map. Other molybdenum-bearing concentrates were obtained between the Churchland and Cherryville plutons. About 8 of these were collected over young silicic intrusives; 9 were not, so the molybdenum is not very consistently associated with the intrusives.

A few NM concentrates from the Slate Belt contain detectable molybdenum, 3 of them over the Flat Swamp member of the Cid Formation, which may therefore have been a molybdenum-rich sediment. The only NM concentrate that contains as much as 50 ppm Mo was collected several miles west of the Newell disseminated copper-molybdenum prospect; too far to be attributed to the mineralization at the prospect.

Molybdenum was found over the Churchland pluton in the M1 fraction as well as the NM fraction, though not in the M.5 fraction (Plate 1). The M1 fractions of most samples contains no detectable Mo over and near the Cherryville pluton, but was found in the M1 fraction of 19 samples collected a little way east of that intrusive, perhaps as a result of mineralization of rocks in the Kings Mountain series.

Southwest of the Churchland pluton and in the Charlotte Belt, 18 M1 concentrates that contain molybdenum were collected over or alongside silicic intrusive rocks. More interesting are the metalliferous samples from that region that are not so closely associated with the very large silicic intrusives. Among those are two M1 concentrates that contain 10-15 ppm Mo collected along Anderson Creek at or near the Newell disseminated Cu-Mo prospect. Other M1 samples with detectable molybdenum are in the eastern and southern parts of the Charlotte Belt; possibly some of them reflect mineral deposits. An association of molybdenum-rich M1 samples with small silicic intrusive masses, as is found at the Newell prospect, would be promising.

Four of the M1 samples with molybdenum from the Slate Belt were collected along the Flat Swamp member of the Cid Formation, which also contains abnormal Mo in the NM concentrates. Five samples were collected over or near axes of anticlines or synclines, suggesting a structural control.

Two M1 samples collected north of the Brown Mountain pluton--in an area with niobian concentrates--contain detectable molybdenum.

The M.5 concentrates contain less molybdenum than the other sample media. Only 3, collected over the Wilson Creek gneiss, contains as much as 20 ppm. Nonetheless, the M.5 fraction is of interest because two samples with 10 or 15 ppm Mo were collected at the Newell disseminated Cu-Mo prospect. Detectable molybdenum in the M1 and M.5 concentrates provides our clearest geochemical evidence of the mineralization at that prospect.

Molybdenum was detected in many of the silt samples from the Slate Belt, but generally in low concentrations, only 15% exceeding 5 ppm. The values appear only locally to be related to structure or stratigraphy. The Uwharrie Mountain gold area and the gold area in the Charlotte Belt, southeast of Charlotte, yield molybdenum-bearing silt; several samples in each area contain 10 ppm.

The silt samples of the western part of the Charlotte Belt and in the Kings Mountain Belt contain a little molybdenum in an area that extends as far west as the town of Cherryville, an area without known mineralization.

The Cherryville quartz monzonite generally yields molybdenum-poor silts. A cluster of three samples at the southern end of the pluton contains 5 ppm Mo. The stanniferous area to the west yielded many silt samples with 5 ppm and a few with 10 ppm molybdenum that might be related to the tin mineralization in the region.

The small cluster of molybdenum-bearing silt samples at the southern tip of the Cherryville pluton may be at the crest of a southerly or southwesterly-plunging body. Molybdenum there may have separated spacially from related tin, which is found over the pluton as well as outside of it. The scattered samples with detectable molybdenum found farther west may therefore indicate apices of other intrusives that may crop out inconspicuously or not at all, but that still are genetically related to the tin and beryllium mineralization of the region.

Molybdenum-bearing silts were also found in the Statesville area about in the same area that yields beryllian silts, reinforcing the inference that the area may have been mineralized.

References

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