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GEOLOGICAL SURVEY

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

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This map which shows the distribution of gold in stream sediments is a product of a geochemical survey of the Charlotte 1° x 2° quadrangle, North Carolina and South Carolina, begun 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 southeastern 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 rather 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 identical. 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. 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 mainly 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 to improve the quality of analyses and to permit recognition of lead possibly derived from ore deposits in the NM and M.5 fraction. 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 in each magnetic fraction were estimated using a binocular microscope. Minerals of special interest were identified optically or by X-ray diffraction, and particles of gold and contaminating bits of lead and copper were removed from the samples.

Each sample was analyzed semiquantitatively for 31 elements using a six-step, D.C. arc, optical-emission spectrographic method (Grimes and Marranzino, 1968). The limit of detection of gold by this method is 20 parts per million.

All analytical data for sample material other than concentrates are taken from a report by 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 Theodore 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 editing the spectrographic data in the RASS computer file. Many maps were subsequently plotted from this file by H. V. Alminas, L. O. Wilch, J. D. Hoffman, and T. L. Marceau. Most mineral distribution maps were plotted by K. A. Duttweiler.

The Charlotte quadrangle extends across almost the entire width of the Appalachian gold belt, so auriferous samples are common but spatial association between known gold deposits and gold-bearing samples is not evident everywhere. Some gold has been transported from the bedrock source, like the gold in tiny flat flakes in samples collected over Triassic rocks in the southeastern corner of the quadrangle, associated with well rounded, coarse grains of kyanite, rutile, and zircon, all of which are alien to the local environment and must, like gold, have been recycled from sediments in the Triassic basin or in the Coastal plain. The gold west of the Triassic rocks and east of the Charlotte belt is of more complex origin; part of it is doubtless recycled from older sediments, like that found over Triassic rocks. Part probably was derived from bedrock sources in the Slate belt, as indicated by an association in the samples with metals that are less likely to be recycled.

The scarcity of auriferous samples in some areas with gold mines or prospects is less easily explained. It may indicate that gold was, in some places, deposited in many widely spaced thin veinlets, providing broad areas in which alluvial gold is present, but without veins that are thick enough to explore individually; in other places, the vein material was concentrated in more persistent fractures, to form veins large enough to be worthy of exploration, but not associated with broadly distributed minor veinlets, so alluvial gold is restricted to the vicinity of the ore deposits.

Gold distribution is shown on the map in two ways, reflecting the manner by which it was found, and, by implication, its mode of occurrence in the samples. The most obvious mode of occurrence is as visible gold, seen while panning or during microscopic examination of the samples. The gold particles were removed from the samples before analysis, but many samples still contained gold that was detected with the spectrograph. This nonvisible gold is shown separately because of the economic and genetic implications.

Visible gold particles are seldom larger than 1 mm. Their shapes range from round to irregular, spongelike, or crystalline. The recycled particles obtained in the southeastern corner of the quadrangle are flat and very small. Pieces with sharp points or edges between crystal faces generally can be related to probable nearby sources. All the gold is yellow, but the depth of color varies between samples, probably indicating variation in the silver content that in turn in part reflects difference in distance of transport.

The nonvisible or "occult" gold was found in many of the samples that contain visible gold, but not in all of them. Conversely, visible gold was not found in all samples with "occult" gold. Tiny particles of "occult" gold or of an unidentified gold mineral may be embedded in one or more other minerals, most likely limonite. Limonite is present in several forms, cubic pseudomorphs after pyrite, irregular masses, and round pellets. The round pellets may represent concretions formed in the soil. Where they formed in auriferous soil, they may have enclosed particles of gold. The cubes and irregular pieces of limonite may have formed by oxidation of sulfides in primary bedrock mineral deposits, retaining gold included in the sulfide minerals, or gold that was trapped by precipitation of limonite, after local movement of iron in ground water. Very small particles of gold that are likely to be engulfed in other minerals and, if free, to be lost in panning, are characteristic of weathered telluride deposits and epithermal deposits of the Carlin type. Telluride minerals have been reported from Piedmont gold deposits but epithermal deposits have not, hence are speculative possibilities. If present, they probably have been metamorphosed and their original appearance obscured.

Structural control of gold mineralization in the South Mountain region is shown by the clustering of auriferous sample sites in an area in which several faults are known. Additional evidence northeast of South Mountain is the belt of seven auriferous sites strewn along the Henry Fork lineament. The spacial association of gold and major fractures is clear, but the gold may not have come from the mapped fractures themselves; rather, it is likely to be in minor fractures associated with the fault. Gold was found in the South Mountains in thin quartz veins, 1/8 inch or less in thickness, that cut various crystalline rocks. James Chapman, a prospector with long experience in the South Mountains, states that that is the characteristic mode of occurrence in the region (oral communication, 1979). The broad area in the northwestern corner of the map, that yields gold-bearing samples, is in and near the Brevard fault zone, minor fractures of which may be hosts for gold veins.

A large cluster of sampled sites with visible gold, about 15 miles southeast of Hickory, is near the north end of the Kings Mountain fault. Presumably the bedrock gold is in minor fractures related to that major fault. The Shuford gold mine in this area was opened at the southern end of a large quartz vein. Trace amounts of bismuth and arsenic are in the soil at the mine. This is the only large auriferous vein in the quadrangle that is accompanied by a broad halo of auriferous sediment sites.

Many samples taken northeast of Statesville, near the Eufala fault, also contain gold, so minor fractures associated with that fault may have been mineralized.

East of Gaffney, gold is in quartz veins that reach thicknesses of several feet, some of which are in northerly trending fracture zones. Most of these veins cut silicate rock, but one of the northernmost mines of this area, the Kings Mountain gold mine, has gold-rich quartz veins in marble (Keith and Sterrett, 1931, p. 8). Keith and Sterrett's map also shows small gold placers associated with old iron prospects west of Cherokee Falls. Some of the iron deposits are gossans. Both visible gold and spectrographically determined gold were found in many samples, but the association with gold mines and prospects is not very close.

References

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