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Distribution of limonite pellets 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 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 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 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 unsifted 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 mineral 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. Limonite pellets are mainly in the M1 concentrate, but they also appear in the other two fractions. The M.5 concentrate contains abundant garnet in the Inner Piedmont, dark ferromagnesian minerals in the Charlotte Belt, and ilmenite in most provinces.

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, and J. D. Hoffman. Most mineral distribution maps were plotted by K. A. Duttweiler.

Many of the heavy-mineral concentrates from the Charlotte 1° x 2° quadrangle contain red to brown iron oxide or limonite pellets (Plate 1). The pellets are subround to round and range in size from 1/32 to 1/8 inches in diameter. Most of them are massive, containing no layering or concentric banding. Many consist of dark red to brown, well-cemented cores surrounded by a band of yellow-brown, somewhat softer material. There are a few that are strongly layered consisting of thin yellow-brown layers which alternate with darker red to brown layers. There does not seem to by any geographic or geologic control on the type of limonite pellet, therefore, they are not differentiated with respect to geographic or geologic province. Limonite pseudomorphs after pyrite and irregular fragments of limonitic rock, perhaps pieces of gossan or laterite, are also present in many, perhaps most, concentrates, but are not considered here.

Concentrates containing limonite pellets are shown on the map by a circle indicating sample location. Pellets are nearly ubiquitous in heavy-mineral concentrates from the eastern two-thirds of the Charlotte quadrangle; an area encompassing the Charlotte Belt, Carolina Slate Belt, and the Triassic Basin. Pellets constitute over 50 percent of some concentrates from this eastern section.

Pellets are very uncommon in the Inner Piedmont Belt; those present are on flat-topped hills near its eastern edge, thus they may be products of weathering on the old Piedmont Plateau. There are very few samples containing pellets in the mountainous northwestern part of the quadrangle.

The manner of distribution and the primary source areas of the pellets are uncertain. There are at least three possibilities: they may have originated in thick soils overlying the area and washed into present streams, or were transported from distant places and concentrated in alluvium and then washed into the streams, or they originated in the stream sediments themselves.

Shown on the map is the distribution of neutral soils in the Charlotte quadrangle. These neutral soils are reported to contain iron or manganese oxide concretions (Caine, 1902; Dorsey, 1901; and McCachren, 1980). The remainder of the soils in the quadrangle are acidic and are not shown on the map because the acidic soils are not reported to contain concretions.

Although concretions have been reported in neutral soils, the areas in the quadrangle containing these soils did not yield unusual numbers of heavy-mineral concentrates that contain limonite pellets. It is possible that concretions are more widespread in acidic soils than is indicated in the literature. It is possible, on the other hand, that the limonite pellets were not derived from the soils. Instead, the distribution of the pellets may have resulted from transportation from areas to the west, over the Piedmont Plateau, where they concentrated in alluvium and washed into present streams or they formed in the stream sediments.

In either origin, the pellets can be useful sample media for geochemical exploration for mineral deposits. If the pellets formed in the soils that provide sediment to neighboring modern streams, their base-metal contents probably reflect the base-metal contents of the surrounding soils. If they formed in the stream sediments, they probably have base-metal contents that reflect the metal contents of the water in the streams, which in turn varies with the metal contents of rocks deep under the neighboring hills. If the wide distribution of the pellets has resulted from multistage transportation over the Piedmont Plateau, perhaps in Tertiary time, then washed from plateau remnants into present streams, they would be useful only to the extent that they adsorbed metal from stream water after they entered modern alluvium.

References

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