A. I. M. E. Virginia Section

ABSTRACTS
Spring Seminar Meeting

"EXPLORATION IN THE VIRGINIA PIEDMONT"

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Regional Geology of the Virginia Piedmont: A

Summary: J. F. Conley, Virginia Division of Mineral Resources

Virginia contains two areas of exposed Grenville basement: the Sauratown Mountains anticlinorium and the Blue Ridge anticlinorium. Overlying the basement on the southeastern limb of the Blue Ridge anticlinorium is a sequence of rocks consisting (from oldest to youngest) of Lynchburg, Catoctin, Candler and Chopawamsic formations. If this sequence is correct the stratigraphic order in the James River synclinorium and even the existance of this synclinorium is questioned. Rocks in the Sherwill anticline are correlated with those in the Smith River allochthon. The Chopawamsic Formation is correlated with metavolcanic rocks to the southwest at Danville. Rocks of the Carolina slate belt are suggested to conformably overlie these metavolcanic rocks at Danville. Rocks of the Quantico and Arvonia synclines are tentatively correlated with each other and are thought to unconformably overlie the Chopawamsic Formation. With increasing metamorphic grade to the southeast, rocks of the Chopawamsic Formation grade into the Hatcher Complex.

A case history in massive sulphide exploration in the Virginia Piedmont from airborne geophysics through drilling.

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Airborne surveys near Mineral, Louisa County, Virginia, detected the M-31 anomaly as a short 6-channel conductor by Input Mark V, and as a grade 2 and 3 conductor by Dighem with coincident magnetic expression of 110 gammas above background. It was readily confirmed by ground EM surveys, has a positive gravity anomaly of 0.5 to 1.1 milligals, and soil with a total base metal content of 2 to 40 times background. Five holes along 1500 feet of strike length intersect gently dipping biotite-sericite schist enveloping 180 feet of biotite-amphibolite schist with 20% pyrrhotite and pyrite. Greatest base metal content is a disappointing 0.09% Cu over 21.5 feet.

M-31 is much more conductive that nearby larger massive base metal sulphide bodies near Mineral, apparently because sulphide occurs in continuous stringers rather than the more common coarse grains isolated in silicate gangue. Pyrrhotite and magnetite explain the magnetic expression but specific gravities of 3.2 and 2.68 for mineralized interval and wall rocks do not account for the gravity anomaly. The geochemical anomaly is the contrast between thin residual soil over the sulphide-bearing interval with the same metal content as fresh rock and barren soil above barren rock.

The stratabound nature, thin lithologic units, minor chemical sediment, and planar contacts suggest M-31 is a minor syngenetic concentration of iron sulphide at the top of a basaltic tuff deposited between rapid accumulations of an epiclastic rock. There appears not to have been local basins or time for precipitation of metalliferous chemical sediment between influxes of clastic debris. However, this interpretation could not be inferred prior to drilling in an area of sparse outcrop.

COMPARISON OF MASSIVE SULFIDE MINERALOGY AT GOSSAN LEAN WITH THE COFER PROPERTY, MINERAL, LOUISA COUNTY, VIRGINIA

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The Great Gossan Lead District and the Cofer prospect represent massive base metal deposits with contrasting mineralogies. The Great Gossan Lead is a NE trending discontinuous mineralized belt, roughly parallel to metamorphic foliation, approximately 20 miles in length in Carroll and Grayson Counties of SW Virginia. The pod-like ore lenses are generally massive, fine grained hexagonal pyrrhotite which exhibits textural (injection into, and interleaving with silicate gangue) and structural (kinkbanding) evidence of having been subject to metamorphism with the enclosing host rocks. Minor amounts of chalcopyrite, sphalerite, galena and pyrite and traces of bismuth, arsenopyrite, cubanite, mackinawite and stannite occur as irregular disseminations in the pyrrhotite.

The Cofer prospect contains a series of roughly parallel discontinuous lenses concordant with the enclosing metamorphic rocks near Mineral, Louisa County. The ores vary from zones of massive granular pyrite to zones of disseminated sphalerite; apparent original compositional banding is visible in many ore zones. Pyritic zones contain significant quantities of sphalerite and chalcopyrite but only minor amounts of galena and arsenopyrite. Sphalerite-rich zones contain significant quantities of pyrite and galena but only minor amounts of chalcopyrite. Trace amounts of electrum, tetrahedrite, mackinawite, pyrrhotite, Cu-Sb-Pb sulfosalts and bornite are dispersed in the ores. Supergene development of covellite and chalcocite are present locally in the upper parts of the ore zones.

Stream Sediment and Soils in Regional Exploration Geochemistry, Northern Virginia

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A regional study of 7,200 km^2 of Northern Virginia was made comparing stream sediment, soils, and stream water in the Piedmont, Blue Ridge, and Valley and Ridge provinces. Four hundred forty samples were analysed by atomic absorption spectrophotometry. The -200 mesh fraction was used for stream sediments and the -60 mesh for soil samples from a depth of 25 cm. A total fusion attack by lithium metaborate (Medlin and others, 1969) was used in sample preparation of soils and sediments. Elements analysed were Au, Mo, Pb, Zn, Fe, Mn, Ni, Cr, and Co.

Anomalous (mean + 2 standard deviations) areas found were: (1) Mo in water in the Fredericksburg area (2) Cu and Au anomalies in the gold pyrite belt near Mineral (3) Ag, Pb, Zn in Blue Ridge and Valley and Ridge (4) Ni-Cr-Co associated with ultramafic rocks.

Stream Sediment Geochemistry in Fluvanna County and the Dillwyn Reference Area, Central Piedmont, Virginia

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A pilot study was made on - 80 + 230 and - 230 mesh fractions of 445 stream sediment samples by hot 1:1 HCl and 3:2 HNO_3-$HClO_4$ acids using AAS for Zn, Cu, Pb, Ag, Fe, Mn, Cr, Ni, Co, Li, and Sr. Results are: 1) areas of known mineralization in the Arvonia syncline were indicated, areas of old gold mines in the Columbia syncline showed up rather poorly except by multi-element analysis, several completely new base metal anomalies were discovered and are being investigated further 2) the reference area showed that both methods of acid attack delineated strong anomalies more than 2 miles downstream or missed mineralization completely depending on topography and drainage 3) in the reference area HCl was about the same as HNO_3-$HClO_4$ for zinc, much better for lead, much lower but clearly anomalous for copper, about the same for silver 4) barite and pyrite could be quantitatively identified in the reference area 5) both Fe and Mn were lower than normal in the reference area 6) metal anomalies in general were independent of magnetite content of sediment and most (>85%) of trace metals were in iron oxide coatings not magnetite 7) combined routine binocular microscope and X-ray examination can be rapidly used for semi-quantitative data on mica, chlorite, microcline, plagioclase, amphibole, epidote and relative amount of iron oxides, which taken together correlate surprisingly well with bedrock type 8) inter-metal correlations were high for all elements analysed (0.5 - 0.8) except Sr 9) statistical computer treatment of multi-element data accentuated anomalous areas, factor analysis delineated underlying geology of areas.

Selected Exploration Case Histories in the Virginia Piedmont

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This paper presents a discussion of the regional Geologic setting and history of exploration in a portion of the Virginia Piedmont.

The area of study is located in Buckingham County, approximately fifty miles south of Charlottesville. Geochemical exploration methods and results are summarized, and optimum sampling parameters for the area are described. Selected soil profile data from three different areas are included. Geophysical data are presented for two anomalies within the study area. The geology of one of the anomalies is described in detail. Tonnage and grade, based upon an extensive drilling program, are presented.

BIOGEOCHEMICAL EXPLORATION IN LOUISA COUNTY

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Current geochemical exploration in the Piedmont Province has been directed toward the use of soils and sediments as primary indications of mineralization. In order to test the effectiveness of biogeochemical methods vegetation and soils at 17 sites along two traverses across a mineralized zone north of Mineral, Virginia, were sampled and analyzed for Ag, Cd, Cu, Pb and Zn. The sites were selected over the host rocks for the massive-sulfide mineralization, as well as over country rock in which sulfide deposits would not be expected to occur. Analyses were done by atomic adsorption using standard digestion and analytical techniques. Plant concentration of a metal expressed on a dry weight basis gives more and higher correlations with soil metal concentrations than does the ashed weight concentration. Mature leaves and twigs of the current year's growth of the oak group appear to be the best plants and plant organs for sampling. The plant concentrations correlate well with either the A or the B soil horizon. Zinc and cadmium concentrations in plants were most frequently correlated with any of the soil metals, but lead in plants was poorly correlated to soil metals; copper and silver are intermediate. Soils developed on the sulfides showed up to 25 fold increase in metal content. Although plants reflected the elevated metal concentrations of these soils the relative metal increases were substantially lower. Nevertheless plants are reliable indicators of mineralization.