GEOCHEMICAL PATTERNS AND STRUCTURAL ALIGNMENTS IN RELATION TO ANTIMONY–MERCURY–TUNGSTEN MINERALISATIONS IN THE NIGDE AREA, TURKEY

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Antimony-mercury-tungsten mineralisations of epigenetic character occur in a crystalline dôme at the base of the Alpine Toros Mountains in southern Central Anatolia, Turkey.

In conjunction with a programme of geological mapping, a geochemical stream sediment reconnaissance survey was carried out and samples were essayed for antimony. The results led to the selection of two target areas for more detailed investigations, including local soil surveys.

The metasedimentary series of the Niğde massif appear to be conform and comprise various gneisses, amphibolites, quartzites, and marbles.

Regional metamorphism within the amphibolite facies probably took place during pre-Hercynian times. Foliation developed parallel to the original bedding. Metamorphic zoning was not observed. The exposed lower part of the series consists of gneisses, amphibolites, and quartzites, the middle part essentially of various marbles with intercalations of amphibolites, and the upper part of gneisses and quartzites with subordinate marble intercalations.

The metamorphic series are intruded by a granodiorite batholite. Pyroxenegarnet tactites with subordinate quantities of scheelite are formed locally at the points of contact between granodiorite and marbles. Non-deformed andalusite-bearing quartz lenses and irregular zones of porphyroblastic garnets are present in the vicinity of granodiorite-gneiss contacts. Thermal metamorphic aureols, however, cannot be identified with mappable isograds. A large gabbro body is exposed at the northern edge of the massif; its age and mode of emplacement are uncertain.

The crystalline massif is surrounded by younger sedimentary formations. Upper Cretaceous and Tertiary clastic sedimentary deposits together with spilitic rocks of Lower Paleocene age occur in a depression between the southern and eastern side of the massif and the Toros orogene. The northern and western slope of the massif are directly overlain by pyroclastic formations of Neogene age.

The crystalline massif itself can be described as having a domal structural form with two anticlinal axes plunging to either side of the massif. Fold structures of a lesser order of magnitude occur in the centre of the dome. The structural trend of the crystalline massif is parallel to the adjacent Toron Mountain chain.

The metasedimentary rocks were subjected to several events of deformation. Regional metamorphism and subsequent minor foldings are of pre-Hercynian age. Major folding and the emplacement of the granodiorite batolithe took place later than the Permian and probably earlier than the Jurassic.

Intensive blockfaulting prior to the Upper Cretaceous affected both the metamorphic series and the gabbro- and granodiorite masses and is perhaps to be attributed to updoming.

Evidences of younger Alpine deformations absent in the massif proper are widely present in the surrounding formations.

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Mineralised and non-mineralised dykes and veins of acid composition occur within the metamorphic rocks of the actual massif in the lower and upper gneiss series. Their emplacement is controlled by fault and joint directions as well as by lithological contacts between gneiss and marble. The economic minerals are scheelite, stibnite, and cinnabar. The main mineralisation is associated with a quartz lode ranging from one to two meters in width and persisting for 1.700 meters in length; the dip varies between 45° and 50°. Stibnite is the most common of the minerals; the occurrence of scheelite and cinnabar is erratic. The mineral paragenesis differs for different dykes.

During the stream sediment reconnaissance survey, 2250 drainage samples were collected over an area of 1600 sq. km. The sample sites were irregularly distributed and co-ordinates were measured with an electronic co-ordinate reader. Most of the samples were taken above the confluence of two streams. They were sieved, sun-dried, and the minus 80 mesh fractions were analysed for hot extractable antimony, using a colorimetric method. Values ranged between 1 and 80 ppm. Anomalous values were defined according to different techniques which ultimately produced similar results. First the frequency distribution of all Sb values was computed. This distribution proved to be a heterogeneous one made up of a log-normal distribution of the background values and a bimodal distribution of values of anomalous character. A threshold value of 10 ppm was estimated.

Next, a moving average technique was employed to prepare trend maps showing different degrees of detail. Individual values deviating significantly from values predicted by the moving average map were considered to be anomalous.

Weighted moving averages were computed and maps drawn to delineate the relationship between the trend of Sb values in drainage samples and the structural trend of the metamorphic series. The spatial distribution of anomalous values appears to be controlled by two factors, i.e., the spatial distribution of the lower and upper gneiss series and the distribution of mineralised dykes. This distribution seems to be independent of the occurrence of the granodiorite mass.

The various maps produced indicated the presence of two large areas which contained several sections displaying clustered anomalous values. The latter sections were assessed individually and those which gave evidence of geological features favorable for ore deposition were selected for soil surveys. In this context it is to be noted that the use of aereal photographs in identifying the blockfaulting system and the location of favourable contacts proved to be extremely useful.

Soils in the area are immature. Samples were collected along lines perpendicular to the observed fault or joint direction at 100 meter intervals. Sb values ranged between 1 and 2500 ppm. These values represent a heterogeneous, multimodal distribution. The threshold value was estimated at 25 ppm for most sections. In a number of instances it has been possible to demonstrate a relationship between Sb distribution and fault systems with indications of mineralisation. These indications are still awaiting follow-up investigation.

Discussion

R.D. Schuiling, referring to a remark of the author's, doubted the usefulness of complementary Sn determinations in stream sediment surveys under certain conditions.

P.H. van der Kleyn did not share this opinion and thought that scheelite mineralisation and Sn dispersion may well be associated.

R.D. Schuiling remarked further that the colours of the recent geological map of Turkey appear to differ from those of the older maps. He wondered whether this was due to age determinations.

P.H. van der Kleyn knew of no recent age determinations and could not explain the change of colours.

G.H. Friedrich asked the author for his opinion regarding the applicability of airborne techniques for Hg determinations in the area under investigation.

P.H. van der Kleyn answered that it might be very useful but he did not think that the authorities would give their consent.