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Methods of data reducing for regional mineralogical mapping

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Mineralogical mapping (so as geochemical mapping) is one of main methods of studying territories while mineral resources prospecting. Heavy mineral sampling of alluvial sediments and data of mineralogical analysis are usually the main sources of obtaining the primary information.

Alluvium mineral assemblages, including the association of heavy minerals (up to 40 minerals), are governed by the following principal factors: (a) the composition of provenance region as a whole; (b) the mineral composition of primary sources; (c) the migration ability of minerals, which depends on their density, grain, size, and chemical and abrasion stability and determines the degree of mineral preservation during transportation and redeposition; and (d) the dynamic characteristics of transporting medium and properties of sedimentation barriers (Patyk-Kara et al. 2001). The influence of many factors and multicomponent character of the system at whole result in the complex multicomponent composition of mineral assemblages in alluvium and lead to substantial complication in their genetic interpretation and mineralogical mapping.

At the same time while mapping, monomineral fields usually have low contrast, enough chaotic state and are hardly interpreted. That is why it is necessary to extract the definite mineral association from the whole data massif, other wards to reduce it is such a way as to purify the massif but not to miss urgent signs. The Principal Components Method (PCM) – one from Factor Analysis modification – is one from methods of reducing of minerals massif. This method helps to distinguish and to cartography the different levels of mineral field heterogeneity and degree of its well-ordering and variability. These levels single out factors, different in intensity and space distribution.

The first level characterizes the most ‘strong’, usually regional factors; each the next level characterizes more insignificant factors. The first (the main) task in studying and genetic interpretation of complex mineral field obtaining in the process of mapping is to distinguish factors, which determine the structure of mineral field. The second task – numerical characteristic and structuralizing of mineral fields in order to get criterions for searching and prospecting of mineral deposits and objects of technogenic pollution.

The task of quantitative distinguishing and estimation of multicomponent mineral fields while mineral mapping of territories can be also adequately solved with methods based on the principle of C. Shennon’s ‘information entropy’ which permit to evaluate the measure of well-ordering of mineral assemblages in space, in particular, the distance of mineral transfer from their primary sources and intermediate hosts (Patyk-Kara & Shur, 1998). These maps added by information on distribution of indicator minerals and their groups permit us to solve various goals of prospecting mineralogy.

One of diamond-bearing regions of Siberia (Yakutia) was chosen as a model territory for methods approbation. One of the peculiarities of this region is that mineral assemblages of alluvium were composed by the way of repeated redeposition of minerals through the system of sedimentary rocks which play the role of different-aged intermediate collectors of heavy minerals, in particular, diamonds and their accessories.

When studying the whole data massif, embracing about 2000 alluvial samples (including 21 minerals in each) from areas, composed by different-aged rocks and deposits, the common tendencies of increasing/reducing (variation dynamics) of average contents were examined and four types of mineral assemblages were extracted. Genetically we distinguish the following mineral assemblages, which reflect the different factors influence and demonstrate different behavior through all rock members:

1. the first “magmatic” group;
2. the second “magmatic” group;
3. the group of metamorphogenic minerals;
4. the group of minerals of oxidized zone and weathered rocks.

It is established that two “magmatic” groups of mineral assemblages are antagonists to each other, it can be explained by different sources, migration ways and conditions of redeposition of minerals.

Results obtained have shown possibilities of combined mineralogical mapping based on reducing of multicomponent mineralogical information.