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The principles of mapping and geoekological evaluation of the montane and plateau geosystems

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Abstract. The main objective of the study is the elaboration of methodical base for geoecological evaluation of mountain and plateu geosystems. The advantage of utilization of threedimensional relief modelling and a wide range of use of geoecological (soil-ecological) meliorative map is presented in the paper. The study explains three principles included in the investigation - the principle of geometrical approach, dynamic principle and genetic principle.

Key words: Valley of the Zarafshan River, geosystem, geoecological map, three-dimensional relief map, Uzbekistan

Geosystems of the Valley of the Zarafshan River appear as a unique objects for investigation of geoecological system mountains and plateus creation. The methods of utilization of three-dimensional relief modelling is presented in the paper.

The geosystems studied are assigned to the marginal Zarafshan megasyncline.

The geological framework of the all geosystems of Zarafshan mountains are bedrocks of paleozoic age, eluvial, deluvial or alluvial products of weathering of paleoizoic limestones, slates, sandstones, rarely granites.

More than 70% of the alpine area and more than 90% of low-montain geosystems are haevilly grazed. Pasture and woodcutting contributed to deforestration of adjacent mountains of the Zarafshan river. The hydrological function of the forests is distinctively important and contributed to economical growth of the adjacent areas and especially of the Valley of the Zarafshan river (Alibekov and Abbosov 2000).

To get the set up goals, i. e. the geoekological evaluation of the montane and plateau geosystems, there is essential to develop the methodical base determinating the geosystems boundaries and methods of their evaluation.

The investigations of more geographers are engaged with geosystems studies, especially their bounderies determination. With respect to their conviction, the geosystems bounderies are well defined in the cases when landscape agents are relatively stable in the space, e. g. the group of lithogenic factors.

We think, the most distinguishable are the geosystem bounderies pictured on topographical map or aerial pictures, if depicted horizontals provide mathematically exact shapes of geologically-geomorphological units.

Sophisticated geosystems delimitaton based on detail analysis of relief forms depicted on the three-dimensional relief map (Stepanov 2006) and others appears as cardinal, permits not only define the geometric bounderies of elements in the frame of geosystems, but define the geometric bounderies of particular geosystems.

The keystone of this method is the image of contour lines, the result is the display of the two elementarily forms of terrene surface – elevation and depression, their synthesis on the map is depicted in the forms of current structures.

Three-dimensional relief map – this is the realistic morphological map with two systematic forms of relief depicted - elevations and depressions. Depicted pattern pictures surface and underground watercourses and in accordance with the designated scale the lithodynamical fluxes as well.

Outlines of natural objects created by gravitation have a gravitation features on the map as well, having image of current structures creating ecosystems.

The geosystems forms on the three-dimensional relief map and consecutively on the topographical or geoecological map are based on their dimension or quantitative indications: position in the field, morphological, genetic, geometric, age characteristics atc. The boundaries of defined surface are the lines breaking off these indications or indicators, or showing maximal alterations. The pattern (the internal structure) of geosystem determines the landscape answering the classis of montane or plateau areas.

On compiled map are obvious the ways of geochemical currents of streams – the formation zones, transit zones and accumulation zones. Based on conditions of soils genesis, their physical and chemical features, the soils of geosystems of montane slopes, submontane plateaus and terraced alluvial plateaus of Zarafshan river are distinctly diversed.

Different aspect have a_significant influence on soil characteristics of geosystems of different altitudinal levels. Erosion appears as an important soil creation agent. The erosion more intensive occurs on South aspects, restricting the leaching during soil creation process, e. g. inhibit the fine-grained weathering accumulation.

This is why the soils covering South slopes have a shallow profile, usually are gravelly, adhering to lime layer. The studies in The West Tian Shan (Stepanov 2006) revealed, that humus and nitrogen distribution in the soils of South and North aspects is different.

The main soil creation agent of submontane plateaus ecosystems in the middle part of the Valley of the Zarafshan river are forests. Forests are soil creation agent for grey soils. Many features of greysols are determined by the forest characteristics and by the geological bedrock. The greysols are fertilely with large magnesium supply.

The montane relief determine the distribution the other landscape components.

The typical soil combination are conditioned by relief, they are regularly repeated on applicable slopes or bedrocks. This way we have formulated the first principle we used in our investigation – the principle of geometrical approach. The geosystem is examined as geometrical object of certain form, the object is subordinated to the form. The heterogenous alluvial deposits are subsoils for geosystems of terraced alluvial plateaus of Zarafshan river. Man made pollution influenced surface and underground waters. The salt accumulation occurs in irrigated zones of montane geosystems. This unfavourable state was confirmed by the Geographical faculty of National University of Uzbekistan and by the Soil science institute. Increasing soil salt concentration and decreasing soil fertility are worrying. For soil fertility is important not only nutrient content, but the geoecological conditions enabling using these nutrients by plants (Volobuev 1963).

To evaluate the man influence to the montane geosystems, is unavoidable creation of specific geoecological (soil-ecological) maps. This includes results of field investigations, large archival material, the results of remote sensing and published data (Sabitova and Ruzikulova 2004, Sabitova and Akhmedov 2005 and others). The basic innovation of compiled maps is lying in the fact, that contoured surface is depicted as relative quantity, reflecting mutual proportion of lengths, extents and other parameters like field concavity or convexity. Using field data and by decoding of aerial pictures was created a geoecological (soil-ecological) meliorative map. The created map is distinguished from the classical map since inludes the primary physical indicator – movement. The gravitation forces the water, fine-grained weathering material and salts migrate downwards, to horizontal positions. Their delimitation by lines makes noticeable the dynamics of geoecological process. This is the second, the dynamic principle.

All the natural forms of geosystem recorded in the field are viseble on the created geoecological (soil-ecological) meliorative maps.

The more significant system arise by conjunction of the single geosystems. On the maps is remarkable patterns, noticeable from aircrafts or spacecrafts.

Compiled soil-ecological map allows to evaluate the water – physical, geochemical and other characteristics, permits not only getting information on geoecological state, but explains the necessity of differnet measures to prevent the negative consequence of humane activities. The current structure analysis enables identification of vulnerable localities in geosystems frames, assess the requirement, set the measures to avert the damage, evaluate and forecast geoecological processes, in time eliminate the adverse ecological performance to mostly exposed sites etc.

The next stage presumes elaboration of the more reliable evaluating scale of geoecological state of the whole montane Valley of the Zarafshan river, which is consider as the most heterogenous geosystem consisting of three subsystems. Each subsystem is specific from the point of view of geoecological state (underground waters, soils, water-physical characteristics), answering the evaluating scales.

The next principle we have implemented in our investigation is the genetic principle. This criterion we applied by the geoecological analysis of geosystem. The investigation of morphostructural peculiarities of the constitution of middle Asia revealed younger and recent structure as rapidly decreasing or ascending, closed or open, well visible on three-dimensional relief map (Toichiev and Sabitova 2002). The basins of underground waters border to these structures and geoecological state of ecosystem depends on their locations. The analysis of soil-ecological and meliorative conditions in closed basins showed, that man-made hydrotechnical systems cause disturbance of underground waters equilibrium. The inflow predominates the outflow, the result is increasing salt concentration in the soils. Closing, the geoecological investigation of geosystems is necessary enlarge with the study on dynamic changes of tectonic structure, implementing the paleographic analysis of investigated area.

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