# THE TAZHERAN SYENITE MASSIF (LAKE BAIKAL): DETAIL GEOLOGICAL MAPPING BASED ON EARTH REMOTE SENSING DATA
(QUICKBIRD-2, IKONOS-2, SPOT-5, LANDSAT-7, RADAR AND AERIAL SURVEY)

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1. The Tazheran massif of alkali and nepheline syenites is situated on the western rocky coast of Lake Baikal (the Ol'khon area). The massif is well known for diversity of rare minerals. The older than previously supposed age of syenites (470 Ma) was discovered lately and their participation in episodes of syn-orogenesis collapse of the Ol'khon collision system became obvious. Deep levels of this system outcrop on the western coast of Baikal. The massif with unique mineralogy beautifully exposed in the coastal cliffs quite unexpectedly turned out to be in the center of attention of geologists studying collision processes. The problem of compilation of present-day geological and tectonic maps of the massif became urgent. We carry out geological mapping of the Ol'khon area with application of conventional and special aerial survey data at scales of 1:100,000, 1:25,000, 1:12,000, and 1:5,000, as well as space imagery of intermediate-, high-, and superhigh- resolution. Complete package of such data is available for the Tazheran massif area. It includes space images from satellites IKONOS-2, QUICKBIRD-2, LANDSAT-7 (USA), and SPOT-5 (France), and spaceborn digital 3D-models of topography. In summer time the steppe plateau area is studied by geological routes, and in winter time the rocky cliffs are studied from the Baikal ice cover. Field observations and images interpretation data are fixed on an ortho-transformed photographic layout (based on aerial images scaled 1:12,000) tied to the world coordinate system. One variant of a relief 3-D model is also based on this layout. Generally, maximal precision in geological boundaries mapping is obtained through application of remote sensing data. Real error in outlining boundaries on orthophotomap doesn't exceed 2.5 m.

2. Based on remote sensing data and field studies resulted in determination of the Tazheran massif position in a regional strike-slip fault zone. The zone extends for 60 km from southwest to northeast and in the area of Orso and Ulan-Nur capes it disappears in the Baikal water area. Outlines of the zone are clearly observed on spaceborn images. On a 15 km long section between Tyrgan and Anga mouth the zone expressed in packages of linear folds and blastomylonite sutures forms a Z-shaped tight bend with the structural elements' turn of more then 90 degrees. The reason for sharp change in linear structure and sigmoidal fold formation is quite clear: the area's largest Birkhin gabbroid massif located in the sigmoid centre, contours of which are bent over by folded host rocks. According to geophysical data this massif is a lopolith or harpolith in shape. In terms of rheology the whole system is sharply inhomogeneous: deformations took place in deep levels of Earth's crust and during metamorphism. Viscosity of rather plastic host rocks of the Birkhin massif was several orders more then that of rigid high-temperature gabbroids. The gabbroid massif responded to shear deformation by rolling and development of fracture system occupied by thousands of thick and extended granite veins. The question arises: what is a relationship between the Birkhin gabbroids and tectonic position of the Tazheran massif of alkali and nepheline syenites? Incidentally, the U–Pb age of Birkhin gabbroids is 499 Ma and they are 30Ma older then Tazheran syenites. It turned out that such relationship exists and impulse for solving of very complex and morphologically intricate tectonic situation was given by remote sensing data analysis. A possibility of observing a whole folded system by one sight is an advantage of space imagery. One can't miss from attention that the Tazheran massif not only occurs in the

same strike-slip zone as the Birkhin massif, but also locates in the center of similarly shaped sigmoid; they differ only in size: the Tazheran sigmoid is 10 times less compared to the Birkhin one. Yet, it seemed strange for the first time: Birkhin sigmoid resulted from rotation of rigid gabbroid massif, but no gabbroids occurred in Tazheran area. In other words: gabbroids are absent, but sigmoid still exists.

3. A riddle was solved with the data of field geological observations. In the endocontact of the Birkhin massif numerous xenoliths of hornfels and skarn were noted and the same rocks as extended but narrow zones were found in the exocontacts. Though Birkhin type gabbroids are not known in the Tazheran massif, hornfels occur widely and occupy significant area in the central part of Tazheran area. It suggests that a subhorizontal lopolith of the Birkhin complex gabbroids inaccessible to direct observations may occur on a shallow depth. This body might cause formation of the Tazheran sigmoidal structure. Only special geophysical studies or drilling might prove or reject this supposition. Both ways could cost big moneys. The decision we suggest here doesn’t cost anything: one should only have a look on a space image and switch on his brain.

4. Characteristic feature of the Tazheran and Birkhin areas is presence of unusual mechanical mixtures with marbles, i. e. specific synmetamorphic marbles mélange, and manifestations of marble–magmatic mingling. Their configuration in plan is strikingly variable and their mapping wouldn’t be possible without remote sensing data. Interpretability of bodies of mechanical mixtures imagery is 100%. This permits to show them on maps with unprecedented accuracy and find approaches to interpretation of genesis of these unusual formations.