International Journal of Innovative Studies in Sociology and Humanities (IJISSH)

ISSN 2456-4931 (Online) **www.ijissh.org** *Volume: 2 Issue: 7 | September 2017*

Gold and Diamond-Bearing Astropipes of Mongolia (Neologism and New Scientific Discovery)

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Summary: *In this paper we present summation of twenty year's investigation of the all gold and diamond-bearing astropipes of Mongolia. Four astropipe geostructures are exemplified by the Agit Khangay (10 km in diameter, 47^0 38' N; 96^0 05' E), Khuree Mandal (D=11 km; 46^0 28' N; 98^0 25' E), Bayan Khuree (D=1 km; 44^0 06' N; 109^0 36' E), and Tsenkher (D=7 km; 98^0 21' N; 43^0 36' E) astropipes of Mongolia (Fig.1). Detailed geological and gas-geochemical investigation of the astropipe geostructures show that diamond genesis is an expression of collision of the lithospheric mantle with the explosion process initiated in an impact collapse meteor crater. The term "astropipes" (Dorjnamjaa et al., 2007-2008, 2010-2011, 2013) is a neologism and new scientific discovery in Earth science and these geostructures are unique in certain aspects. The Mongolian astropipes are genuine "meteorite crater" geostructures but they also contain kimberlite diamonds and gold. Suevite-like rocks from the astropipes contain such minerals, as olivine, coesite, moissanite (0,6 mm), stishovite, coesite, kamacite, tektite, khamaravaevite (mineral of meteorite-titanic carbon), graphite-2H, khondrite, picroilmenite, pyrope, phlogopite, khangaite (tektite glass, 1,0-3,0 mm in size), etc. Most panned samples and hand specimens contain fine diamonds with octahedrol habit (0, 2-2,19 mm, 6,4 mg or 0,034-0,1 carat) and gold (0,1-5 g/t). Of special interest is the large amount of the black magnetic balls (0,05-5,0 mm) are characterized by high content of Ti, Fe, Co, Ni, Cu, Mn, Mg, Cd, Ga, Cl, Al, Si, K. Meanwhile, shatter cones (size approx. 1.0 m) which are known from many meteorite craters on the Earth as being typical of impact craters were first described by us Khuree Mandal and Tsenkher astropipe geostructures. All the described meteorite craters posses reliable topographic, geological, mineralogical, geochemical, and aerospace mapping data, also some geophysical and petrological features (especially shock metamorphism) have been found, all of which indicate that these geostructures are a proven new type of gold-diamond-bearing impact geostructure, termed here "astropipes". The essence of the phenomenon is mantle manifestation and plume of a combined nuclear-magma-palingenesis interaction.*

MAIN REAL RESULTS

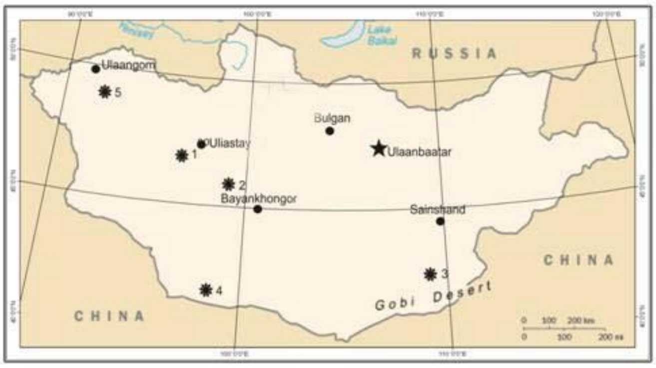

Figure 1: *Location of the Mongolian diamond-bearing astropipe geostructures*

Type I, studied in 1997–2017: 1, Agit Khangay (47° 38' N; 96° 05' E) 2, Khuree Mandal (46° 28' N; 98° 25' E); 3, Bayan Khuree (44° 06' N; 109° 36' E); 4, Tsenkher. (43° 36' N; 98° 21' E)

Type II, insufficiently studied diamond-bearing geostructure: 5, possible astropipe geostructure "Flying Saucer" (49° 25' N; 92° 05' E);

1. THE AGIT KHANGAY ASTROPIPE GEOSTRUCTURE

The Agit Khangay astropipe geostructure in western Mongolia was formed within the Permian granite massif. The impact geostructure is at the northern edge of the Zavkhan tectonic zone, some 60 km southwest of Uliastay city (Fig.1). The crater is surrounded by a raised rim with a total diameter of about 10 km. The country rock of the crater is an Upper Paleozoic magmatic assemblage overlain in places by Quaternary alluvial deposits. The crater rim or bank consists of a disrupted ring-like ridge reaching a height of about 450–500 m, and the crater itself is infilled with shattered and shocked granite (agizite-new name from this geostructure), which is characterized by ejecta, cataclasite, and authigenetic breccia. Agizite is new Mongolian word of gold and diamond-bearing rock which was multiple published characteristic for Agit Khangay astropipe geostructure. Agizite is atypical (unorthodox) suvite-like or beresite-like metasomatic rock which contains microdiamond, moissanite, pyrope, stishovite, coesite, kamacite, tektite and etc. Most panned samples and hand specimens contain fine diamonds (Fig. 2) with octahedral habit (size of 0.2–0.43 to 2.19 mm with a weight of 6.0–6.4 mg or 0.034–0.1 carat); gold (from 0.1 to 3–5 g/t); platinum; moissanite (mineral of meteorite-siliceous carbon size of 0.6 mm); pyrope; rhenium; chrome spinel; kamacite; khangaite (tektite glass, 1.0–3.0 mm in size); picroilmenite; coesite; khamrabaevite (mineral of meteorite-titanic carbon); fayalite; sheelite; graphite-2H, etc.

Impact shock effects include the presence of coesite and pseudotachylite in samples of granites and abundant vesicular and flow-structured quartz glass. Our work on acid-dissolved residues of impact melt rocks from the crater and from panning has revealed the presence of silicon carbide (moissanite) crystals, closely associated with impact microdiamonds. Of special interest is the large amount of magnetic spherules (meteoritic dust or rain) gathered in the region. These black magnetic balls (Fig.3; from 0.05–0.1 to 1.0–5.0 mm) are characterized by high content of Ti, Fe, Co, Ni, Cu, Mn, Mg, Cd, Ca, Cl, Al, Si, K, Au and represented by oxides of iron. The spherules differ noticeably from micrometeorites and because of their contents of iridium, rhenium, khangaite and khamrabaevite. They are probably not terrestrial tektites.They may alien planetary materials, possibly cosmic relics of the impacting Agit Khangay 'body'.

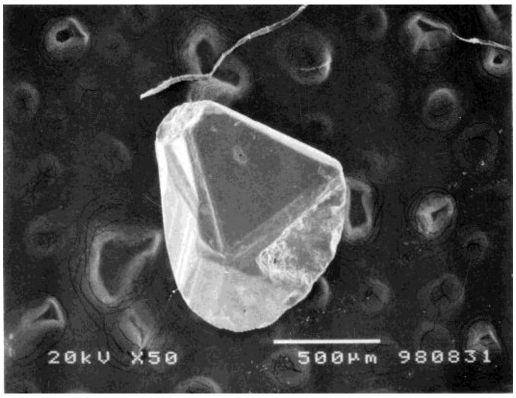

Figure 2: *Trihedral diamond crystal (face of octahedron) from agizite of the Agit Khangay astropipe geostructure.*

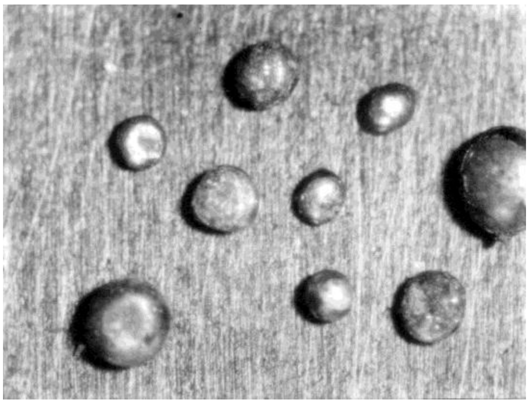

Figure 3: *Black magnetic balls or meteoritic (iron) dust (size of 0.1 to 5.0 mm) from the Agit Khangay astropipe geostructure*

By means of morphostructural, geochemical, as well as by mineral concentration methods, we have been able to identify the unique occurence of gold associated with diamonds in the Agit Khangay crater. Primary occurrences of gold with contents 0.1 to 3–5 g/t are confined to the central crater up to 2–2,5 km in plane. These primary gold occurrences are accompanied by placer gold and scheelite of before meteoritic origin.

An analogous gold-bearing impact crater, 'Khuree Mandal' has also been discovered in central Mongolia.

ISSN 2456-4931 (Online) www.ijissh.org Volume: 2 Issue: 7 | September 2017

2. THE KHUREE MANDAL ASTROPIPE GEOSTRUCTURE

The Khuree Mandal astropipe geostructure (Figs. 4-6), 220 km N-NW of Bayankhongor city in central Mongolia is within the Upper Paleozoic volcanic intramontane Buutsagaan depression with a diameter of 11 km and has a similar geomorphological position as the Agit Khangay astropipe crater (Fig.1). As shown in Fig. 4, the principal morphostructural elements of the astropipe ring are: Inner (small) diamond-gold-bearing pediment plain (I); Inner ring-shaped rise or Inner tectonomagmatic bar (Central hilly rise-II); Central ring depression (III); Outward circular bar (IV); Inner ore-bearing crater mould (V). The astropipe relief morphostructures have an inversion nature with respect to the non-meteoritic country geostructures. The main difference is characterized by radial-ring morphostructures (Fig. 4), which are represented by various ore-bearing and mineral formation complexes. The Khuree Mandal astropipe geostructure within the upper Paleozoic volcanic depression (in central Mongolia) in diameter 10 km has an analogous geomorphological position, as an Agit Khangay astropipe crater.The suevite-like rocks(fluidizat) and lavabreccia from various parts of crater and central rise are showed presence of picroilmenite, pyrope and gold(from 0,13 g/t to 6,33- 32,0 g/t) closely associated with the mantle and impact microdiamonds.

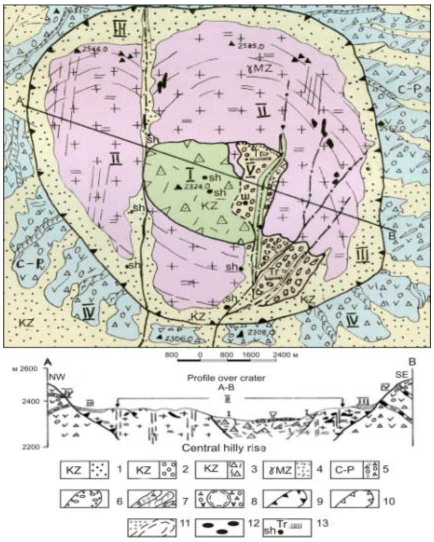

Figure 4: *Geological map and cross-section of the Khuree Mandal astropipe geostructure*

1-Cenozoic: coarse-fragmental rocks composing terraces (conglomerate, gritstone with diamonds, tektite glass, cosmic spherules); 2-Diluvial and diluvial-proluvial deposits with gold, moissanite; 3-Allogenic lavabreccia boulder, gravel, sandstone, loamy sand with gold mineralization, meteoric matter; 4-Mesozoic: mural palingenetic granite with fluidizate-like loamy sand volcanic breccia and plural acute-angle xenoliths; 5-Carboniferous (Buutsagaan Formation)–Permian (Khureemaral Formation): terrestrial terrigenous-volcanic rocks; 6-Mesozoic intrusive contact with diamond and gold-bearing coarse-fragmental rocks; 7-Radiating gold-bearing basic dykes and lithic-crystal tuffite; 8-Pseudoslate cover, neck, veins, authigenic breccia, tagamite-like complex forming radiating and ring structure; 9-Stepped boundary between a central hilly rise and ring depression; 10-Stepped boundary between an inner (small) diamond-gold-bearing pediment plain (I) and central hilly rise (II); 11-Arcuate fault and ring fracture inside of the central hilly rise; 12-Suevite or fluidizate-like granitic breccia; 13-Prospecting trench (Tr) and pit or shaft (sh;ш).

Suevite-like rocks (fluidizate) and volcanic breccia from various parts of the crater and central hilly rise are characterized by the presence of olivine, coesite, moissanite, khondrite, picroilmenite, pyrope, phlogopite, orthite, and gold (from 0,13 to 6,33-32 g/t) closely associated with mantle- and impact-derived fine diamonds (Fig. 6; 0.1–0.5 to 2.5 mm in size). Special pressure and temperature conditions are necessary to account for the coexistence of phlogopite, pyrope, picroilmenite, gold and other accompanying accessory minerals with the diamonds. It is reasonable to assume that the Khuree Mandal astropipe geostructure is closely related to diamond-bearing rocks and is analogous to the diamond-bearing lamproites of the 'Argail' pipe of Australia (2). So-called shatter cones that were produced when the shock wave traversed the Permian volcanogenic rocks were first described by us in connection with the Khuree Mandal and Tsenkher astropipe structures (Figs. 5; 8). Meanwhile, shatter cones are known from many meteorite craters on the Earth as being typical of impact craters.

Figure 5: *Shatter cones (size approx. 1.0 m) in the Khureemaral basic lava flow in the Khuree Mandal astropipe geostructure. GPS: 46˚31'50"N; 98˚20'04"E. Photo of Ts. Amarsaikhan.*

Figure 6: *Diamond octahedra from the Khuree Mandal astropipe structure. The size of crystals is 0.1–5.0 mm.*

3. BAYAN KHUREE ASTROPIPE GEOSTRUCTURE

This circular 1 km-diameter astropipe geostructure in southeastern Mongolia (Figs. 1; 7) is located in 500 km to southeast from Ulaanbaatar, about 100 km south of Sainshand city. Mesoproterozoic micaschists strike NE and in places are covered by Cretaceous sediments and Quaternary sands. The crater depression lies across folded country rocks is filled by eolian sands. The apparent depth of the crater depression is about 30–40 m. The rim reaches 25–30 m high and consists of fractured and brecciated schists. According to Dorjnamjaa et al. (1) the clastic cement of the allogenic breccias contains impact glass (3-5 mm), shocked quartz grains, pyrope, olivine, chrom diopside and microdiamonds (Fig.7; 0,5 x 0,4 mm in size). Ejected brecciated blocks are found at a distance of ~300 m from the eastern crater rim. A remnant of the postimpact terrigenous sedimentary cover, with early Cretaceous fossils, occurs not far from the rim and consists of sandstone lenses which bear shocked quartz grains that have one or two sets of planar deformation features. According to radiometric dating on impact-melt rocks, the crater was formed close to the late Jurassic-Cretaceous (145-150 ±20 Ma) boundary.

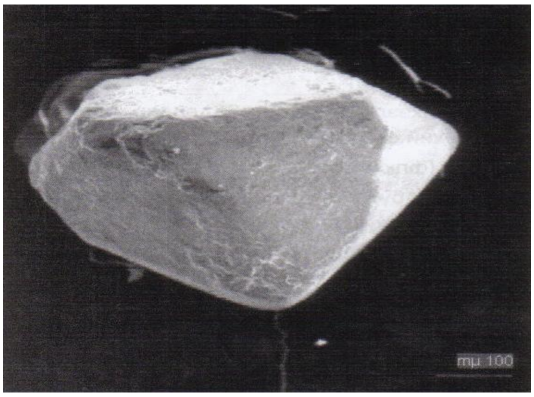

Figure 7: *Diamond octahedron from the Bayan Khuree astropipe geostructure. Size of crystal is 0.5 x 0.4 mm (2)*

4. TSENKHER ASTROPIPE GEOSTRUCTURE

The Tsenkher astropipe geostructure (Figs.1;8) in southern Mongolia is present at the southeastern edge of the NW–SE-trending mountain range, the Edrengyin Nuruu, and is located on a Cenozoic basin fill that is gently dipping to the south. Komatsu et al.(6) first discovered and reported the possible impact structure during his examination of RADARSAT standard mode images of the region for paleoenvironmental reconstruction. We studied this geostructure in detail during 2006–2007. It's diameter is about 7.3 kilometers, surrounded by a raised rim and with a relatively well-preserved blanket of ejecta materials.

The region is dominated by the Altay Mountain Ranges, which are primarily Silurian-Devonian island-arc and continental Mesozoic-Cenozoic platform assemblages. A panned sample contains impact glass, pyrope, olivine, gold and moissanite. Shatter cones have been revealed from volcaniclastics within the northwestern part of the raised rim (Fig. 8). Shatter cones or cones of shattering are formed as a result of action of the shock wave connected with meteoritic impact. So-called shatter cones were produced when the shock wave traversed the Devonian volcanoclastics. Meanwhile, they are known from many meteorite craters on Earth as being typical of impactites. Cones of split off outwardly reminds a texture (cone-in-cone) in rocks. The hatching on surface of cones is scattered in form of horse's tail from top of cone to their base. Dorjnamjaa et al. (2012) have established for the first time the presence of stony-irons meteorites from this astropipe geostructure. Stony-irons (Pallasite) meteorites are composed of nickel-iron and silicate minerals in about equal proportions, an usually consist either of well shaped crystals of olivine in a continuous matrix of nickel-iron, or of plagioclase and pyroxene set in discontinuous nickel-iron matrix. As everybody knows the pallasite comprise only about 4 per cent of the known meteorites.

Figure 8: *Shatter cones (size approx. 15.0 cm) in Devonian volcaniclastics of the Tsenkher astropipe geostructure. GPS: 43˚37'N; 98˚20'E*

5. CONCLUSIONS

As a result of our data the marked specifications of gas composition of the astropipe's rocks indicate their likeness to composition of the kimberlite's gas. Summing up what we have said it allows to suppose on possible formation of diamonds in the Mongolian astropipes with the meteorite bombing of surface of the earth's crust. The various rocks(agizit, fluidizat, impact breccia, etc.) of the astropipes by level of concentration of an hydrocarbonic gas, of the adsorbed form(HCG) are close to kimberlite. Consequently, detailed geological and gas-geochemical investigations show diamondgenesis is the expression of the collision of the litho –spheric mantle with meteor impact collaps explosion process. The essence of the phenomenon is mantle manifestation and plume of the combined nuclear-magma-palingenesis interaction (4,5).

ACKNOWLEDGEMENTS

This research was supported by science-technological project of Mongolia "Mongol Diamond" in 2004-2006 and by additional scientific support from the Moscow State University(MSU) and the CNIGRI ALROSA Co.Ltd.We are grateful to Dr. L. S. Kondratov and Academician D. M. Voinkov (former VNIIGeosystem, Moscow) for the adsorbed form gas's analyses in impactites, Garanin V. K. (Problem laboratory of diamond deposits, Geological department of MSU) and Dr.

Zinchuk N. N (CNIGRI, ALROSA) for their scanning electron microscopy (SEM) studies of the diamond microcrystals.We are also thankful to Academician R. Barsbold, Ph. D. Yo. Khand and Dr. Kh. Tsogtbaatar (Director of Institute of Paleontology and Geology, MAS) for their constructive assistance cordially and sincerely.

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