Toward A New Scientific Discovery of the Unique Gold and Diamond-Bearing Agit Khangay and Khuree Mandal Astropipes of Mongolia

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ABSTRACT: *This paper presents summation of twenty-one years investigation of the unique gold and diamond-bearing Agit Khangay and Khuree Mandal astropipes of Mongolia. These astropipe geostructures are as selective examples amongst for four impact meteorite craters of Mongolia (Figure 1): 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). The term "astropipes" [1] is a neologism and new scientific discovery in Earth science and these geostructures are outlandish in certain aspects. Particularly the Agit Khangay and Khuree Mandal astropipes are genuine "meteorite crater" geostructures but they also contain kimberlite diamonds and gold. Suevite-like (agizite) rocks from the astropipes contain such minerals, as coesite, stishovite, moissanite (0.6 mm), kamacite, tektite, khamravaevite (mineral of meteorite-titanic carbon), graphite-2H, chondrite, picroilmenite, pyrope, phlogopite, khangaites (tektites, 1.0-3.0 mm in size), olivine, etc [2]-[3]. Most panned samples and hand specimens contain fine diamonds with octahedral habit (0.2-0.5 mm, 6.4 mg or 0.034-0.1 carat) and gold (from 0.13 to 6.33-32.0 g/t). Of special interest is the larger number 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. These described meteorite craters possess 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 and diamond-bearing impact geostructure, termed here "astropipes". The essence of the phenomenon is mantle-crust mix and fluidization of the combined nucleosynthesis-magmatic evolution-palingenesis interaction.*

Keywords : *Astropipe, Impact crater, Crater rim, Central uplift, Funnel, Shatter cones, Diamond, Moissanite, Khamravaevite, Gold, Spherules meteoritic iron, Khangaites, Agizites*

I. INTRODUCTION

In 1997, D.Dorjnamjaa managed to prove that the Agit Khangay crater is a meteorite crater and further reported [1]-[7] the Mongolian astropipes are genuine 'meteorite crater' geostructures and best preserved on local relief. They also contain kimberlite (mantle-derived) diamonds and gold. According to current research [4]-[5], this mighty catastrophe took place within few seconds for example during the Paleogene (about 66.0 million years ago). Within the terrestrial planets, this process is considered as a rare phenomenon that occurs mainly in the evolution of the atmosphere, lithosphere, and mantle. As everybody knows [7]-[11] that kimberlites are the principal source of diamonds. The diamonds are xenocrysts derived from disaggregation of mantle material, and the kimberlites are merely the vehicle that transported them from the upper mantle (>150 km depth below the graphite-diamond phase boundary) to the crust [8]-[9]. Diamond-bearing kimberlites are located in Archean cratons such as the Kaapvaal craton of southern Africa, Siberian craton and the Kimberley craton in W. Australia.

The main positions of this model are as follows: a) geochemical composition of impact diamond-generated rocks a sequence of their bedding within the astropipes and diamond contents are interrelated and determined by depths of impact-generated or kimberlite-like melt formation within mantle; b) an additional factor of geophysical, petrological and geochemical diversity of impact-generated formation is considered to be the compositional inhomogeneity of magma generation zones of the mantle at the expense of inclusions of eclogite-like paragenesis, enhancing the intensity of mica kimberlite formation comparing with baric standard and their corresponding diamond contents; c) evolution of impact diamond-generated magmatism had been proceeding from more deep-seated (>100 km) levels to less deep-seated (<100 km) ones, and magma generation zones in the considered astropipe regions, that was likely to trace a displacement of lithosphere plate under a hot spot within the Paleo-Asian ocean structures. We must recognize that the mantle substructure is revealed close to terrestrial surface within the Mongolian astropipe geostructures. True, the proposed model of impact diamond-generation composition, although approximating rather closely to reality, calls in many respects for refinements according to isotope geochemical and mineralogical data, also geophysical log. The pursuance of fundamental investigations of discovered astropipe geostructures with the complex mastering of information on mantle inclusions, mineralogical, structural petrography, geochemistry and petrochemistry is quite possible.

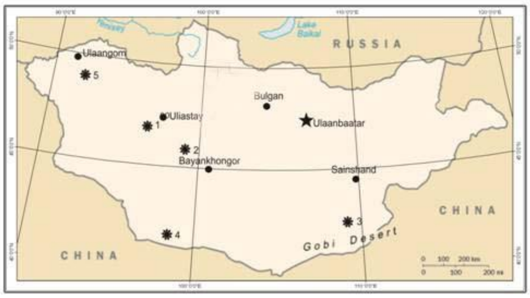

Figure 1 Location of the Mongolian diamond-bearing astropipe geostructures [1]

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 gold and diamond-bearing geostructure: 5, possible astropipe geostructure "Flying Saucer" (49° 25' N; 92° 05' E)

II. MAIN REAL RESULTS

According to D.Dorjnamjaa et al. [1]-[4], [12]-[15] the Agit Khangay and Khuree Mandal gold and diamond-bearing ring impact astropipe geostructures are established for the first time in Mongolia. These astropipes are wonderfully preserved from erosion and active denudation, and characterized by both well natural exposures and diversity of different impact-derived and shocked magmatic rocks and minerals.

1.The Agit Khangay astropipe geostructure

The Agit Khangay astropipe geostructure in western Mongolia was revealed at the northern edge of the Zavkhan tectonic zone, some 60 km southwest of Uliastay city (Figures 1, 2a, 2b). The crater is surrounded by a raised rim with a total diameter of about 10 km. The host rock of the crater is an Upper Paleozoic magmatic assemblage overlain in places by Quaternary alluvial deposits. The crater rim consists of a disrupted ring-like ridge reaching a height of about 450–500 m, and the crater itself filled up with shattered and shocked granite (agizite-new name from this geostructure), which is characterized by ejecta, cataclasite, and authigenic breccia, as the impact melt. Agizite is new Mongolian word of gold and diamond-bearing rock which was multiple published characteristic for Agit Khangay astropipe geostructure [1]. Agizite is atypical (unorthodox) suevite-like metasomatic rock and shock breccia which contains microdiamond, moissanite, pyrope, stishovite, coesite, kamacite, tektite and etc. Term "suevite" was established for the first time by E. M. Shoemaker and E. T. C. Chao in German Meteorite crater Ries in 1961 [7].

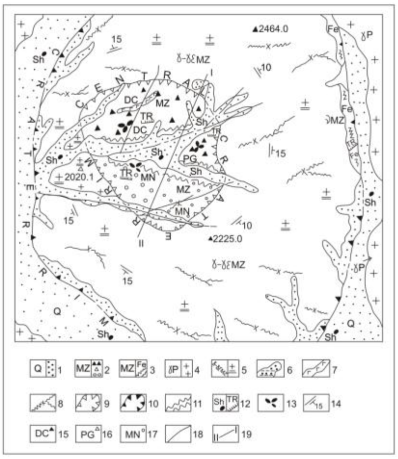

Figure 2a. Geological map of the Agit Khangay astropipe geostructure

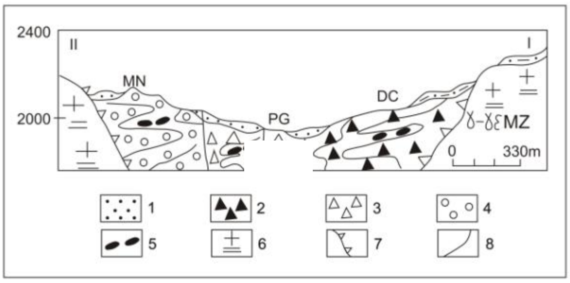

Figure 2b. Cross-section of the Agit Khangay geostructure lengthways line II-I

Figures 2a and 2b. 1- Quaternary: coarse-fragmental alluvial and proluvial loose rocks (conglomerate, gritstone, channel gem sands, gold-bearing sands); 2- Mesozoic: central crater depression filling up with coarse clastic (boulder, shingle, gravel, explosion breccia) and variegated impact ejecta and suevite-like rocks (agizite) with minerals produced under high pressures and temperatures (see Figure 2b, 2-4); 3- Mesozoic minor gabbroid intrusion: sulfide-bearing iron occurrence (Goat valley); 4- Permian porphyroclastic potassic rosy granite; 5- Gold-bearing mattress-like alkaline granite, syenite-aplite and syenite-pegmatite with skialith (see Figure 2b, 6); 6- Meteorite impactite eruptive or explosive reject within central crater depression; 7-Gold-bearing porphyritic whin dike; 8-Gold-bearing aplite and noble quartz vein; 9- Cusps or sharp boundary between an inner central crater depression and central uplift (see Figure 2b, 7); 10 - Cusps between a central uplift and outer ring depression; 11- Porch-like mountain wavy slope (sculptured relief) composed of diluvial, diluvial-proluvial and colluvial loose sediments with gold, diamond, moissanite, garnet, coesite, tektites (khangaites), black magnetic balls, scheelite, platinum, etc.; 12- Prospecting trench (Tr) and pit or shaft (Sh);13- Diamond-bearing suevite-like (agizite) or fluidizate-like fine - clastic, shock and pyroclastic breccia (see Figure 2b, 5); 14- Periclinal mattress-like jointing, line foliation, horizontal foliated fracture within ring ironshot granitoid intrusion; 15-17-Gold and diamond-bearing locality with various precious, noble, rare metal, minerals and elements:15- Diamond Cairn (gold, diamond, moissanite, khamrabaevite, pyrope, chrysoberyl, emerald, ilmenite, chrom spinel, kamacite, tektites, scheelite, graphite-2H, etc.), 16- Piebald Goat (gold, moissanite, pyrope, fayalite, scheelite, black magnetic balls or iron meteorite, tektites, coesite, kamacite, stishovite, etc.), 17- Middle Nose (gold, platinum, rhodium, rhenium, REE (La, Ce, Eu), chrome-diopside, titanomagnetite, galenite, scheelite, black magnetic balls, etc.); 18- Arcuate and distributed fault, cognate fissures and vertical fissuring; 19- Cross-section lengthways II-I

Most panned samples and hand specimens contain fine diamonds with octahedral habit (size of 0.2–0.43 to 0,5 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 (Figure 3); pyrope; rhenium; chrome spinel; kamacite; khangaites (tektites, 1.0–3.0 mm in size); picroilmenite; stishovite; coesite; khamrabaevite (mineral of meteorite-titanic carbon); fayalite; scheelite; 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 panning has revealed the presence of silicon carbide (moissanite) crystals, closely associated with impact microdiamonds. Exceptional interest is the larger number of magnetic spherules (meteoritic dust or rain) gathered in the region. These black magnetic balls 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 (Figure 4; from 0.05–0.1 to 1.0–5.0 mm). The spherules differ noticeably from micrometeorites and because of their contents of iridium, rhenium, tektites, and khamrabaevite. Tektites are found only in certain, rather limited areas of the Earth's surface. They are named according to the area in which they are found and the principal types are: australites, from the southern part of Australia, Tasmania and coastal islands; philippinites from the Philippine Islands and southern China; javaites from Java; malaysianites from Malaysia; indochinites from Thailand and Indochina; Ivory Coast tektites from the Ivory Coast, West Africa; bediasites from Texas, United States; Georgia tektites from Georgia, United States; and moldavites from western Czechoslovakia. According to D. Dorjnamjaa and D. Soyolmaa [6] Mongolian tektites has been named as khangaites. They may alien planetary materials, possibly cosmic relics of the impacting Agit Khangay 'body'. Using morphostructural, geochemical, as well as by mineral concentration methods, we have been able to identify the unique occurrence 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 a plane.

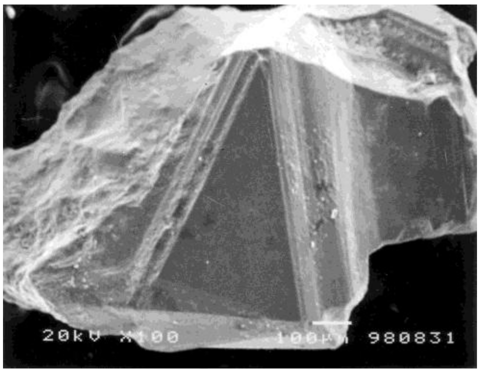

Figure 3 Trihedral moissanite crystal (SiC) from agizite of the Agit Khangay astropipe geostructure [5]

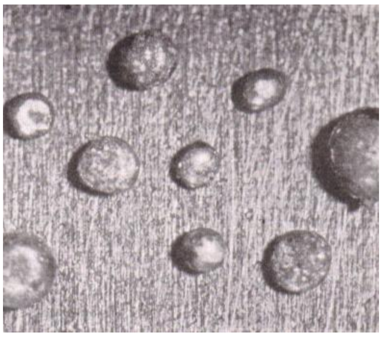

Figure 4 Black magnetic balls or meteoritic (iron) dust (size of 0.1 to 5.0 mm) from the Agit Khangay astropipe geostructure

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

2. The Khuree Mandal astropipe geostructure

The Khuree Mandal astropipe geostructure (Figures 1, 5), 220 km N-NW of Bayankhongor city in central Mongolia is within the Upper Paleozoic volcanic intermontane Buutsagaan depression with a diameter of 11 km and has a similar geomorphological position as the Agit Khangay astropipe crater (Figures 2a, 2b). This geostructure is a beautifully-circular depression in the hilly and partly filled by the Cenozoic loose rocks. As shown in Figure 5, the principal morphostructural elements of the astropipe ring are [1]: Inner diamond and gold-bearing pediment plain (I); Inner ring-shaped uplift or Inner tectonomagmatic bar (Central uplift-II); Central ring depression (III); Outward circular bar (IV); Intramontane ore-bearing superimposed trough (V). The Khuree Mandal astropipe geostructure within the upper Paleozoic volcanic depression (Central Mongolia) in diameter 11 km and rim consists of a dissected ring of hills, reaching a height of about 400-450 m above the superimposed basin level. The suevite-like rocks or fluidizate (Figure 6) and volcanic breccia from various parts of the crater and central uplift 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 (Figure 7; 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. Rocks and minerals from the crater show evidence of shock effects, ranging from planar features in quartz grains to the presence of stishovite (Figure 8) and coesite. The Khuree Mandal astropipe geostructure is analogous to the diamond-bearing lamproites of the ‘Argail’ pipe of Australia [8]-[10]. 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 (Figure 9) and Tsenkher astropipe structures [1], [16]. I should be emphasized that shatter cones are known from many meteorite craters on the Earth as being typical of impact craters [5]-[7]. It is very characteristic that within central uplift palingenetic granitic rocks including an abundance of the acute angled xenoliths (Figure 10) are common. In connection with this phenomenon and other an accomplished fact the author is introduced the concept of meteorite impact and nuclear magmatic dissolved solids. It is possible to assume that the cosmic body intrudes into the Khuree Mandal basement. Pressures up to 10 mills. Bar (10^{12} Pa) and temperatures up to 30 000^{0}C prevail on the contact surface. Consequently, the shock wave passes through the surface of the crater and is reflected back through the meteorite, thus meteorite and melted impactite are vaporized like in an explosion.

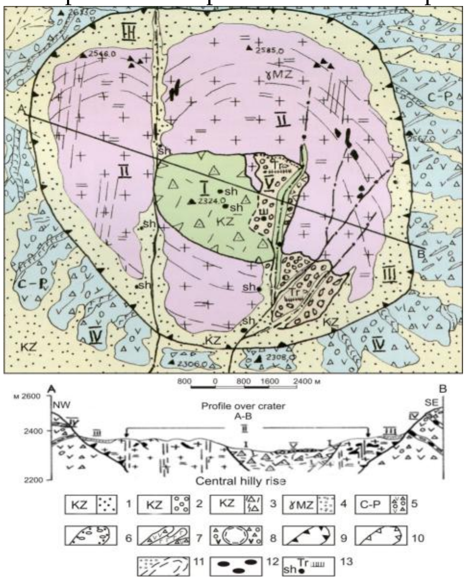

Figure 5 Sketch geological map and cross-section of the Khuree Mandal astropipe geostructure [1]

1-Cenozoic: coarse-fragmental loose rocks composing terraces (conglomerate, gritstone with diamonds, tektites, cosmic spherules); 2-Diluvial and diluvial-proluvial deposits with gold, moissanite; 3-Allogenic lava breccia boulder, gravel, sandstone, loamy sand with gold mineralization, meteoric matter; 4-Mesozoic: erosion remnants of the 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 dikes and lithic-crystal tuffite; 8-Pseudoslate cover, neck, veins, authigenic breccia, tagamite-like complex forming radiating and ring structure; 9- Cusps between a central uplift and ring depression; 10-Cusps between an inner (small) diamond and gold-bearing pediment plain (I) and central uplift (II); 11-Arcuate fault and Ring fracture inside of the central uplift; 12-Suevite or fluidizate-like granitic breccia; 13-Prospecting trench (Tr) and pit or shaft (sh;ш).

Figure 6 Polygenetic shock suevite or fluidizate-like impact breccia - conglomerate including tektites and kimberlite-like diamonds from the Khuree Mandal astropipe geostructure

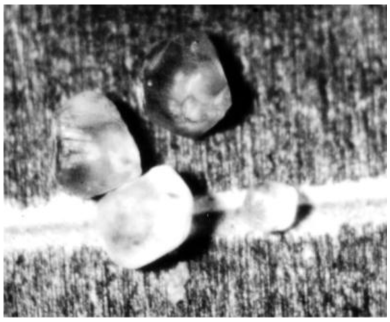

Figure 7 Diamond octahedra from the Khuree Mandal astropipe geostructure. The size of crystals is 0.1–5.0 mm.

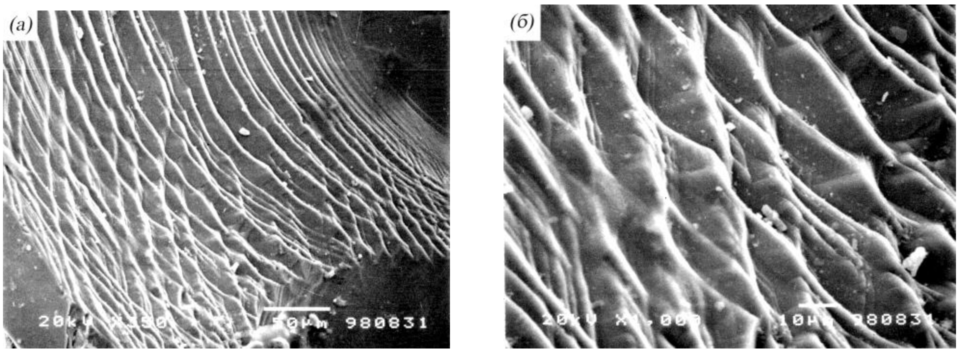

Figure 8 Reticulate structure of stishovite, sharp-edged fragment (a) and a small magnification (б) of one in (a) from the Khuree Mandal astropipe geostructure

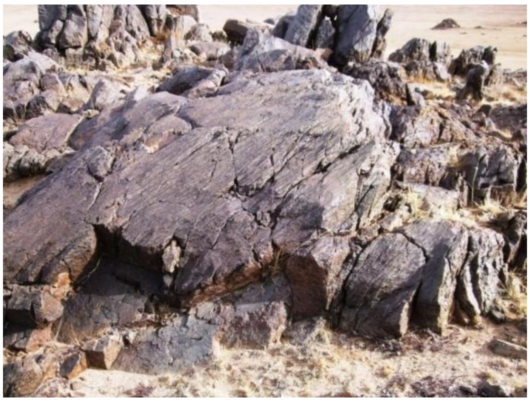

Figure 9 Shatter cones (size approx. 2.0 m) in the Khureemaral basaltic lava flow in the Khuree Mandal astropipe geostructure GPS: 46˚31′50″N; 98˚20′04″E

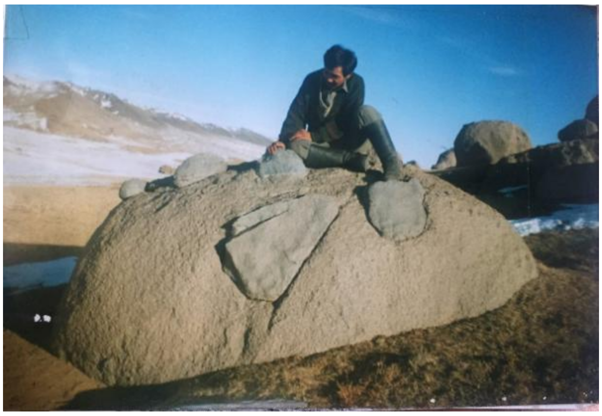

Figure 10 The acute angled xenolith-like (nest) melted impactite resulting from meteorite impact and nuclear magmatic dissolution (palingenesis)

III. Conclusions

1.Summing up what we have said it allows to approve a possible origin of closely associated with the hypervelocity meteorite impact of surface of the earth's crust. As impact melt the various rocks (agizite, fluidizate, impact breccia, etc.) of the astropipes by level of diamond in the Agit Khangay and Khuree Mandal astropipes which concentration of a hydrocarbon gas, especially of the adsorbed form (HCG_{af}) are close to kimberlite. Consequently, detailed geological and gas-geochemical investigations show diamond genesis is the expression of the collision of the lithospheric mantle with meteor impact collapse explosion process. The main cause and essence of the peculiar sparse phenomenon is mantle-crust mix and fluidization of the combined nucleosynthesis- magmatic evolution-palingenesis interaction.

2. To all this must be added that we have the top-priority scientific objectives in relation to unique gold and diamond-bearing astropipes except an economic potential. It is chronological dating of the percussive episode of meteorite cratering within the Mongolian area.

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