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REPUBLIC OF ANGOLA
GEOLOGICAL POTENTIAL REPORT

A BRIEF OVERVIEW OF THE POTENTIAL OF ANGOLA MINERAL RESOURCES

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The concessions we have studied at various times are shown in Fig. 1.

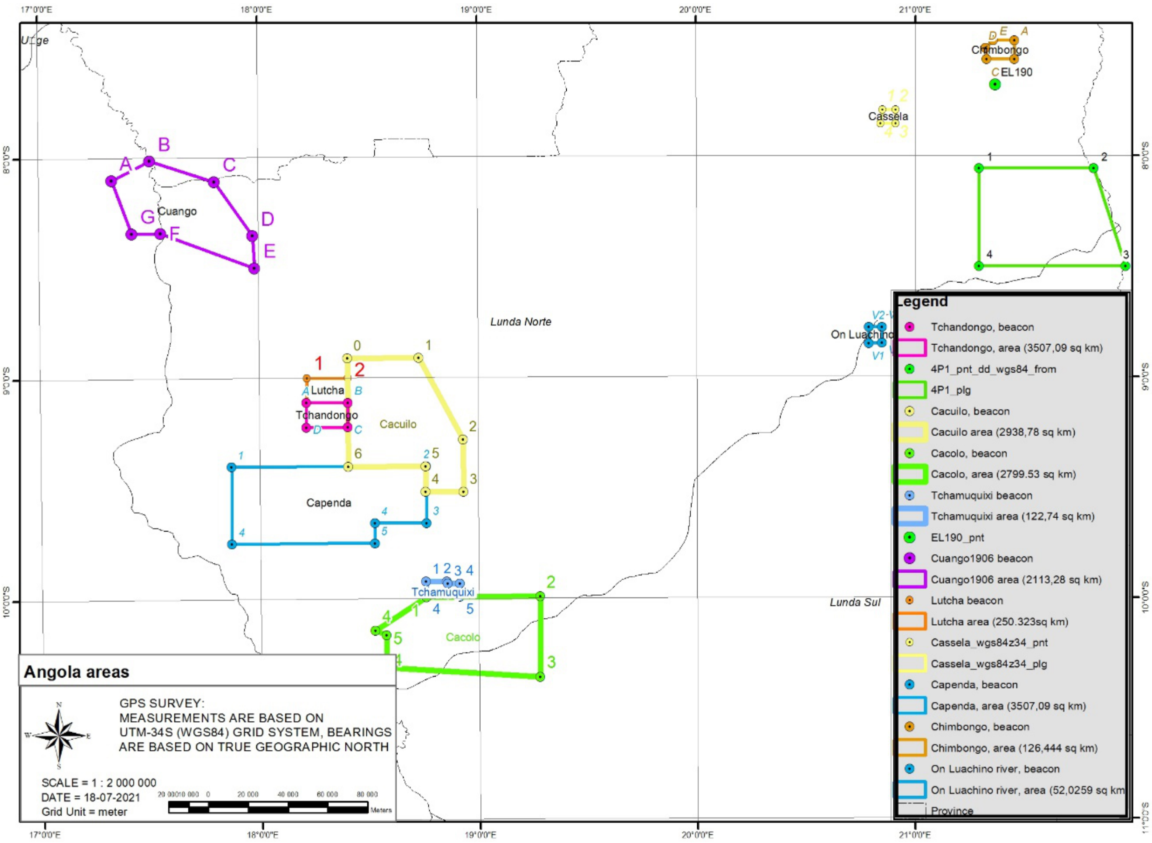


Fig. 1. Concessions studied by us and their titles

TCHANDONGO CONCESSION

Within one of the concessions, Tchandongo, we first identified geological structures that we interpret as caldera complexes of kimberlitic magmatism (Bobrov, 2020). The weathering and subsequent disintegration of these structures supply clastic material into the fluvial alluvium of nearby rivers, where successful diamond mining is currently being carried out.

Field investigations during the reporting stage of the Tchandongo Concession, as of 17.09.2021, established the following:

Two primary groups of potentially economically viable geological structures are distinguished within the concession area:

a) those localized within sedimentary rocks;

b) those localized within crystalline rocks of various origins (sedimentary, magmatic, and hydrothermal-metasomatic).

a) Structures developed in sedimentary rocks

Within the Tchandongo Concession, four main types of paleovalleys hosting heavy mineral/metal placers are recognized (Fig. 1). These differ in the structure of the placer profile, lithological composition of the productive layer(s) ("gravel"/"kashkal"), elevation levels, primary source rocks of erosion, as well as the nature and location of intermediate collectors.

Several subtypes can be distinguished among them.

Type A structures represent a predominantly erosional type of paleovalley, varying in maturity depending on which part of the river valley system the alluvial deposits are found. These deposits consist of different lithofacies types (shown in turquoise and light blue in Fig. 1).

This is a strongly erosional type associated with relatively younger valleys (marked in purple in Fig. 1), where placers were formed under conditions of intense incision and a specific mode of sediment accumulation. There is clear differentiation in types of accumulation based on lithofacies of the alluvium (point-bar, channel deposits, etc.), often with signs of incision into high terraces or colluvial-deluvial fans. It is highly likely that the source of the heavy minerals is local, derived from geological structures located within the concession. An example of such structures in crystalline bedrock is the caldera system located in the central part of the concession (Fig. 1 – D1 to D3), described in detail below.

Within this river valley system, another subtype — **Type A1** — can be distinguished. These are narrow, transverse, V-shaped tributary valleys that cut across all structural elements of the main river valleys. They are narrow (up to 100 m wide), short (up to 200–300 m long), and contain insufficient gravel volume for long-term exploitation. However, they may be considered by the Client as a potential reserve asset for the company if they are located logistically close to the main mining operations.

Type A structures belong to the drainage system of the Lulo River up to the natural constriction located in the eastern segment of its course. They are fed by the Lulo River itself, as well as by four elongated linear (narrow) erosional watercourses that flow into the Lulo River in the northwestern corner of the Concession. The drainage system also includes one sublatitudinal collector (Fig. 1, index 1) on the far west, and three others—two meridional (2 and 3), and one submeridional (4)—located to the north-northwest, beyond the northern boundary of the Concession.

Type B Structures

The morphology of Type B valleys (Fig. 1) differs from the previous types in that, due to their geomorphological characteristics, they function as natural reservoirs, separated from the Type A valleys to the west and from Type C valleys located beyond the eastern boundary of the Concession. Within these valleys, the fluvial system retains well-defined lower terraces/floodplains, preserved from channel erosion. In Fig. 1, they are indicated with the index B1. This represents a predominantly accumulative valley type, associated with mature drainage systems (shown in turquoise and light blue in Fig. 1), where placer formation occurred under conditions of relatively calm and intensive sedimentation. The primary sources of mineral input are largely from bedrock located beyond the northern and eastern boundaries of the Concession.

Additionally, clearly defined fluvial channel segments within the Concession are classified as subtype B2. On the western side, this drainage system is separated from adjacent Type A watersheds by at least two natural constrictions (functioning as dams or natural barriers), which are presumably represented by dyke-like bodies (denoted as "E" in Fig. 1). These are likely sub-synchronous with the kimberlite magmatic phase (indicated in purple with east-facing hachures).

The size of these valleys ranges from 1–1.2 km in width to approximately 6–8 km in length. Type A valleys directly adjoin the transverse constrictions and are connected to Type B valleys through narrow channels (indicated in purple-blue on Fig. 1).

Type C Structures

These are located beyond the eastern boundary of the Concession and should unquestionably be regarded as a significant reserve area for potential diamond exploitation, pending the acquisition of mining rights.

Type C includes extensive valley systems, represented by terrace/floodplain relicts (C1) and channel segments of the upper reaches of the Lulo River (Fig. 1). The only major collector feeding placers in this area is a tributary river entering the Lulo from the north and trending from the northeast to the southwest.

This is a predominantly accumulative valley type, similar to Type B, associated with mature drainage systems (shown in turquoise and yellow-blue shades on Fig. 1), where placer deposits were formed during the final phase of river system development under relatively stable depositional conditions. The sources of the heavy minerals are largely bedrock units located north and east of the Concession. These valleys are analogous to Type B but occupy a more extensive area and are situated further east of the Concession's boundary.

b) Structures developed in crystalline rocks

Type D Structures

Type D structures are represented by a system of numerous circular, sub-circular (isometric), and linear features of varying sizes, clearly interpreted from satellite imagery and SRTM digital elevation models of different resolutions. Most of these are of interest as potential targets for prospecting and exploration for kimberlite-related lithologies, including lamproites, lamprophyres, and other related potentially diamondiferous rock types. These features are hereafter generically referred to as kimberlites.

The most prominent and significant geological feature is Structure D, which comprises a central caldera (D) and at least three partially eroded relics of other calderas—D1, D2, and D3 (see Fig. 1). These are interpreted as potential remnants of central-type volcanic caldera complexes (with multi-vent diatremes), formed synchronously with the kimberlite magmatic phase of the Republic of Angola.

Central Caldera D

This structure is represented by an almost perfectly circular ring approximately 3 km in diameter, with numerous inferred feeder conduits (presumably pipe-like bodies). These features require ground-based magnetic surveying at a scale of 1:5,000–1:10,000, combined with a grid of cross-pattern ground-penetrating radar (GPR) profiles, in order to delineate potential pipe structures. These targets should subsequently be verified by drilling or trenching to obtain rock samples for laboratory analysis.

Satellite Caldera D1

Located west of the central structure, Satellite Caldera D1 is represented by a partially eroded remnant, with the northern segment being the best preserved (Fig. 1). The structure has an approximate diameter of 1 km. Ground magnetic surveying at a scale of 1:5,000–1:10,000 should be conducted, along with orthogonally-oriented GPR profiles to identify pipe-like bodies. These should then be verified through core drilling or excavation of trenches to recover rock samples for analytical testing.

Satellite Caldera D2

This is a partially preserved caldera fragment, with significant erosion along its eastern and southern margins. Its estimated diameter is around 1.5 km. Several pipe-shaped bodies are interpreted within this structure. Ground-based magnetic surveys at a scale of 1:5,000–1:10,000 are recommended, complemented by cross-pattern GPR profiling to detect and define the subsurface geometry of potential pipe structures. Subsequent verification should be carried out through drilling or trenching, followed by sample collection for laboratory geochemical and petrographic analyses.

Satellite Caldera D3

This structure is represented by a semi-circular fragment, eroded along its northwestern margin. Its preserved portion measures approximately 2–2.5 km in diameter. Ground-based magnetic surveying at a scale of 1:5,000–1:10,000 is recommended for the preserved segment, along with orthogonally-oriented ground-penetrating radar (GPR) profiling to delineate potential pipe-like intrusions. These targets should then be confirmed through drilling or excavation of trenches to obtain rock samples for subsequent laboratory analysis.

The eroded portions of all the identified calderas are considered an evident potential source of diamonds within the Lulo River basin, particularly to its north, west, and southwest.

2 KEY FINDINGS OF THE SURVEY

- In the central part of the concession, multiple caldera complexes have been interpreted, represented by calderas D, D1, D2, and D3. These structures are believed to be a potential manifestation of relatively young kimberlitic magmatism.
- The modern and buried valleys of the Lulo River within the western half of the concession provide insight into primary kimberlitic sources concentrated in the central concession area (Calderas D–D3). The Type D structures are interpreted as potential components of a central-type volcanic edifice, synchronous with the kimberlitic magmatic activity of the Republic of Angola.
- These Type D structures should be the principal focus of exploration for primary deposits hosted in crystalline rocks, concurrently with the continued delineation of alluvial diamond concentrations. This dual focus significantly increases the likelihood of locating the primary diamond sources — those kimberlitic or ultramafic bodies that supplied the heavy minerals (including diamonds) into the alluvial system. It is crucial to note that such primary sources, if confirmed, are expected to possess a significantly greater resource potential compared to the alluvial diamond concentrations (placers) derived from them.
- Within the concession territory, the paleovalley of the Lulo River, especially in its western and partially northern sectors, accumulates clastic (diamond-bearing) material almost exclusively as a result of the erosion of the Type D calderas. Available data provides no substantial evidence supporting the hypothesis that diamonds (at least the majority) are transported from the upper reaches of the paleovalley located to the east, both within and beyond the concession boundaries. These eastern paleovalleys (Type A) should be considered high-priority targets for exploration and resource assessment.
- At the Mushindo site, ground-penetrating radar profiling has been conducted, revealing key morphologic features of the floodplain–terrace placer deposits along the Lulo River, composed primarily of gravel/cachkal (local term for diamondiferous gravels). GPR surveys are ongoing, aimed at identifying the most favorable zones for extraction — specifically, saucer-shaped depressions along the paleovalley floor that correspond to thicker accumulations of productive placer horizons.
- Amid widespread thinning or even pinch-outs of the gravel layer within the active mining pit at Mushindo, a test excavation of two mechanized trenches positioned away from the pit revealed a productive gravel horizon thickness of approximately 1 meter.

[1] – Feeder channels of paleovolcanoes, presumably represented by kimberlites.

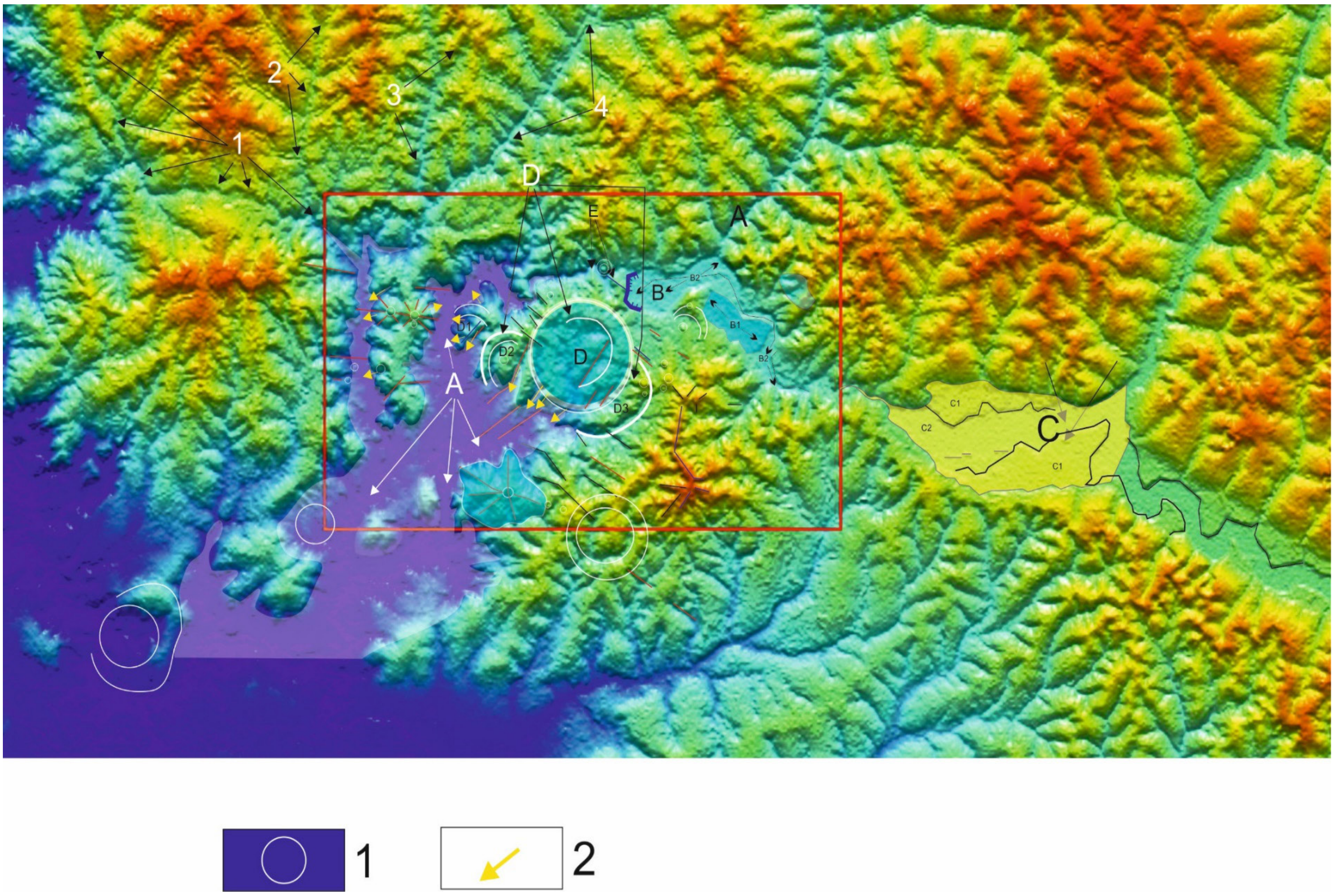


Figure 2. Main Types of Geological Structures (SRTM Model and Principal Geological Features of the Tchan-dongo Concession (Lunda Norte, Angola))
1 – Ring structures (presumably of kimberlitic composition); 2 – Directions of clastic material transport

- The extensive floodplain section of a Type B valley (specifically along its southern margin and central part), surveyed through pedestrian reconnaissance traverses, demonstrated the fundamental potential for commercial development—contingent upon positive sampling test results—due to its significant spatial extent.

- The floodplain of the Lulo River located to the east, beyond the boundaries of the Concession (Type C valley), occupies a vast area, making it a strategically important target for future exploitation, subject to the acquisition of extraction rights.

- Small satellite valleys of Type A1 (measuring approximately 100 × 150–200 m), which intersect all structural components of the primary river valleys, are insufficient for independent, long-term exploitation. However, they may be considered by the Client as a reserve asset of the company, particularly if located in logistical proximity to major mining operations across extensive floodplain territories.

- Within the productive gravel horizon, company personnel identified metallic phases exhibiting well-defined crystalline structures and predominantly isometric shapes. Preliminary visual analysis suggests they could have both endogenous (magmatic) and meteoritic (impact) origins. If found in significant quantities and if composed of silicides (natural alloys of metallic silicon with other metals), they may hold considerable scientific and industrial potential. These phases will be analyzed in detail at the precision laboratory of the Institute of Geological Sciences of the National Academy of Sciences of Ukraine using methods such as electron microscopy, microprobe analysis, ICP-MS spectrometry, and others.

- Within the crystalline bedrock of the Concession, basaltic flows and dolerite dikes—typically associated with kimberlitic magmatism—were identified during field mapping.

- Additionally, reconnaissance fieldwork in crystalline rocks revealed the presence of rare-metal and rare-earth-bearing pegmatites, as well as ores of non-ferrous metals. Samples have been submitted for laboratory analysis to evaluate their potential economic value.

- Ongoing ground-penetrating radar (GPR) profiling of floodplain areas in various valley types will help assess the extent of zones composed of productive gravel horizons and the diamond content of collected samples. This information, when combined with archived sampling data (provided via local contact Sebastião Pedro) on previously recorded diamond concentrations in placer deposits, will allow delineation of the placers, estimation of their resource potential, and calculation of the gravel and diamond resources contained within them. Estimating the volume of the productive horizon will also help determine processing rates and the projected duration of mining operations on Concession sites.

We conducted geological and geophysical exploration that confirmed the diamondiferous nature of the area.

Productive, diamond-bearing lithified gravellites were identified within the alluvial sequences of the placer deposits.

Figure 3. *Sample of lithified conglomerate (gravelite) from high terraces, discovered within the local Lulo 5 area of the Tchandongo Concession.*

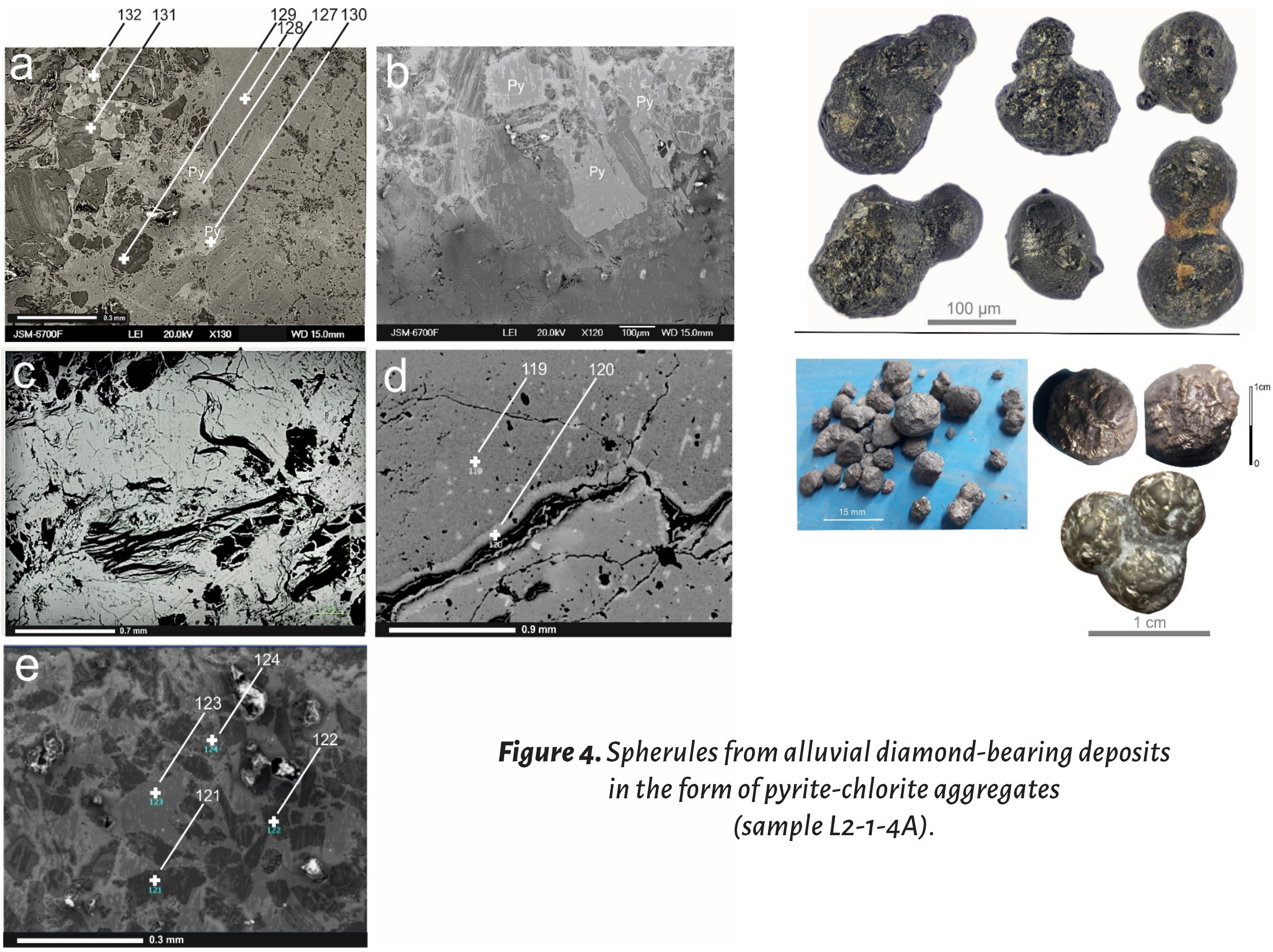


Figure 4. *Spherules from alluvial diamond-bearing deposits in the form of pyrite-chlorite aggregates (sample L2-1-4A).*

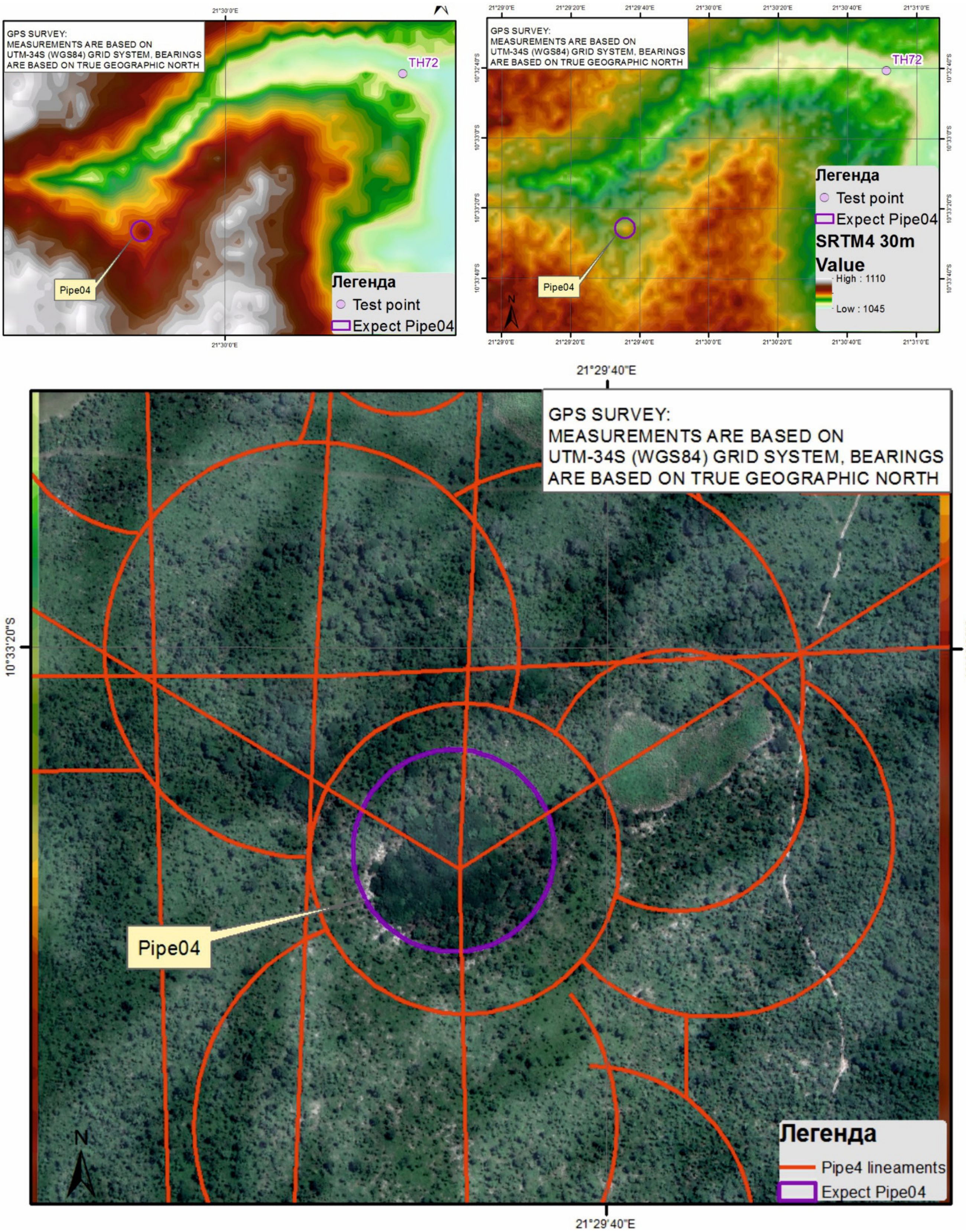


Figure 5. *Pipe 4, Sakauliwa Concession (Angola). Visualization of the location using SRTM models of various resolutions (top) and a Landsat image (bottom).*

Figure 6. *Vesicular plagioclase-phyric basalt and picrite-basalt pahoehoe lavas (sample A34, 10°47'50" / 20°36'51", elevation 1120 m a.s.l.) Sample size: 15–18 cm along the long axis.*

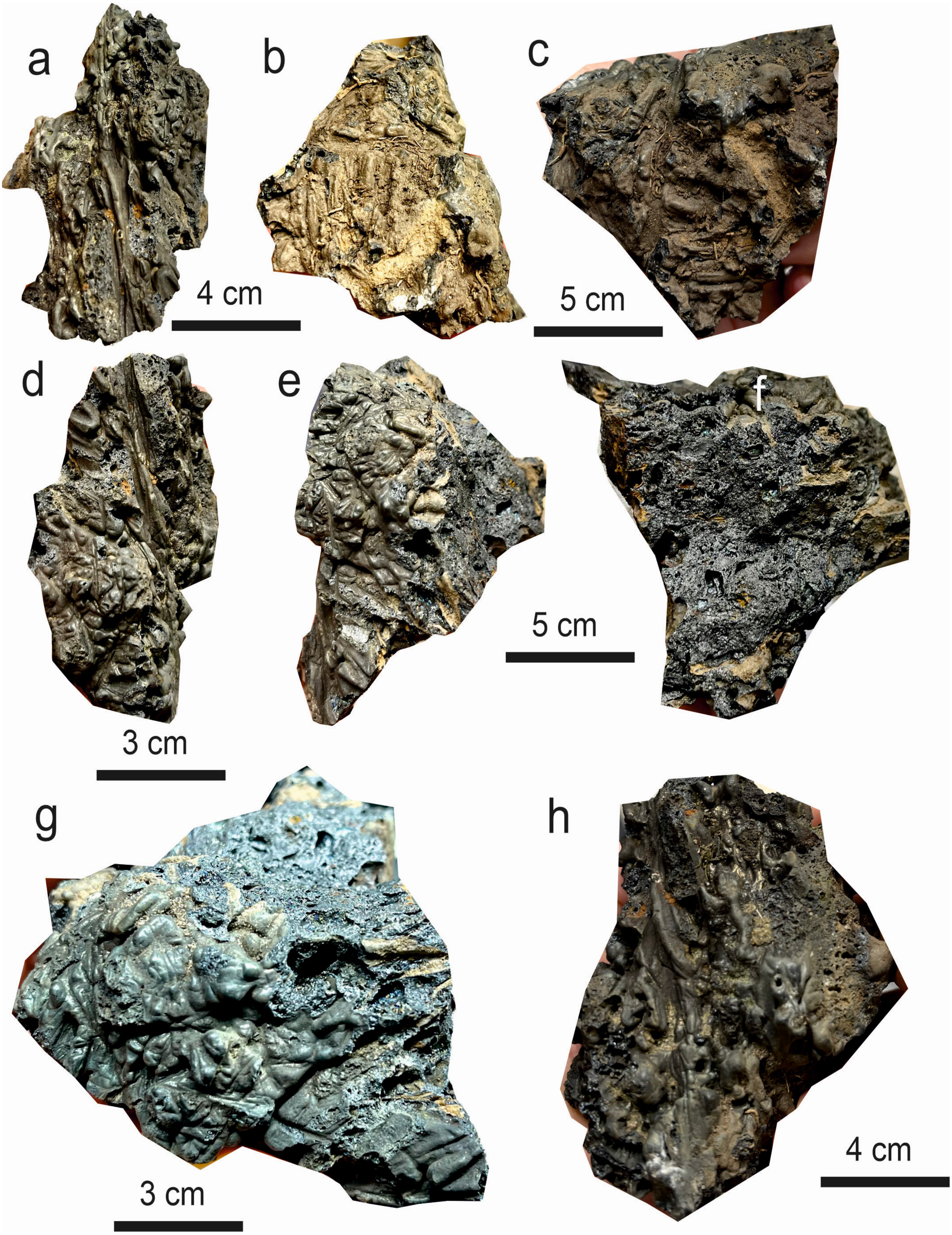


***Fig. 7.** Variants of vesicular basaltic and picritic-basaltic pahoehoe lavas on the surface of lava flows.*

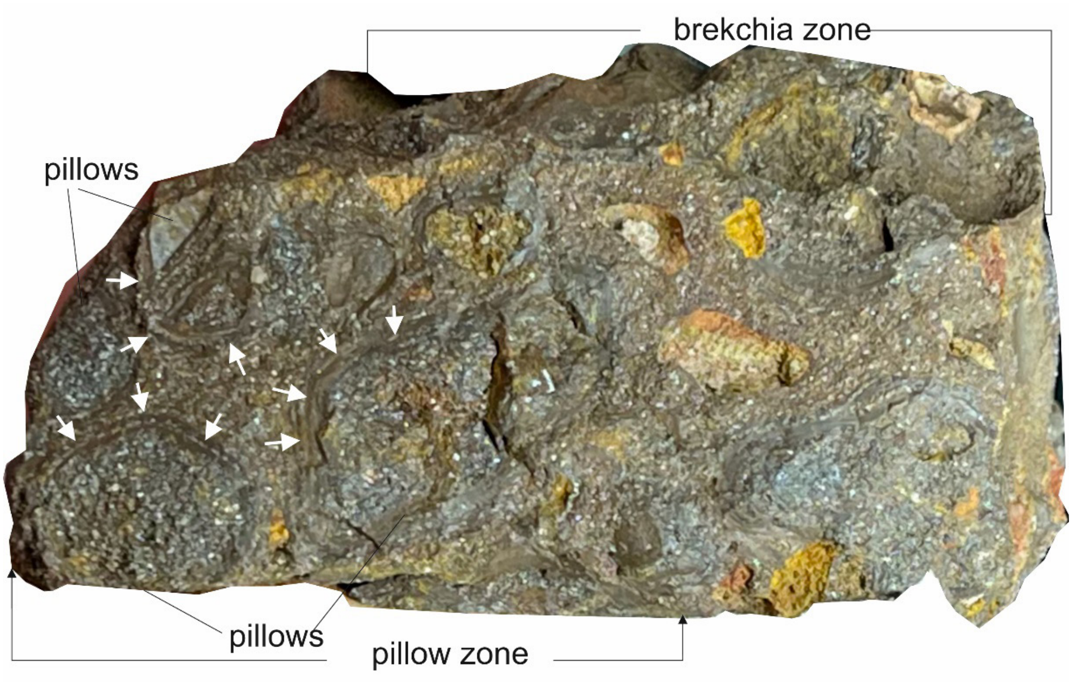


Fig. 8. *Contact between the layered and pyroclastic parts of a lava flow.*

Fig. 9. *Kimberlite tuff breccias with picroilmenite and pyrope (sample A74), Muaguenge area.*

In **Fig. 9d**, the lower part of the outcrop displays lava with minimal clastic content, grading upward into basal breccias of a lava flow, with a tendency toward increasing fragment abundance and size.

Most of the breccias may be classified as agglomeratic and lapilli-bearing tuff-lavas, with maximum clast sizes reaching 10–15 cm. Clasts in the tuff are angular and generally irregular in isometric shape. Compositionally, they include sandstones, marls, basic igneous rocks, quartz, and basalts.

In **Fig. 10**, the directional trend is clearly visible — in this case, a decrease in both the quantity and size of lithic and mineral clasts from the basal part of the flow toward its top.

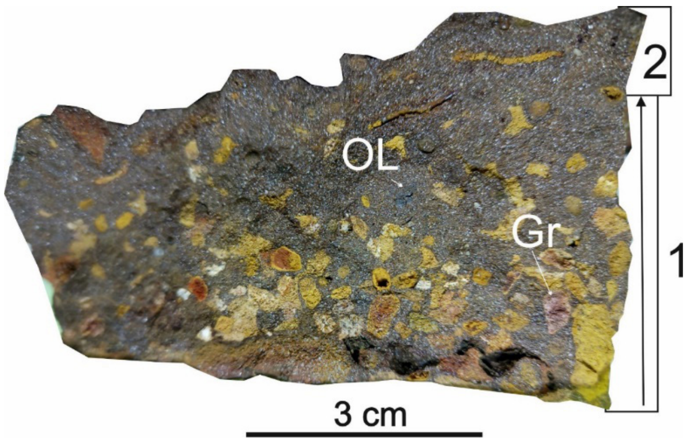
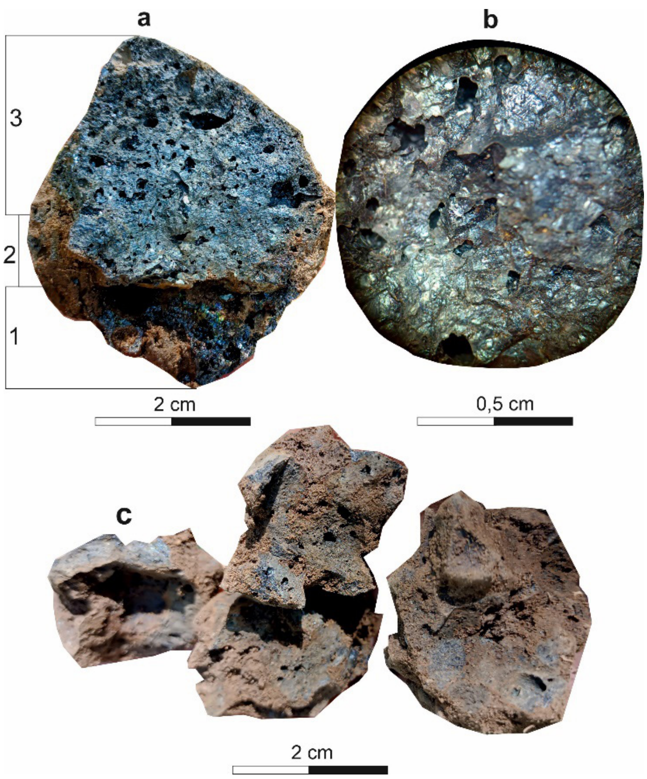


Fig. 10. *Kimberlite breccia with olivine (Ol), picroilmenite (PIL), and pyrope (Gr), weakly weathered, Muaguenge area.*
Arrow indicates direction toward the top of the flow.



Fragments of lava flows exhibit ropey (pahoehoe) surface textures (**Fig. 7**). Downsection, these grade into plagioclase-phyric lavas composed of vesicular volcanic rocks (also **Fig. 7**). Throughout the volcanic association, outcrops of agglomeratic and lapilli tuffs are widespread, showing zonal distribution of clasts of various lithologies and porphyritic mineral segregations.

Evidence supporting the volcanic (rather than tectonic) origin of the breccias includes:

- diverse clast composition,
- signs of interaction between clasts and mineral phenocrysts with the melt,
- and a distinct zoning in both composition and clast size throughout the lava flow profile.

The composition and texture of the volcanic flow matrix are represented by a combined silicate-metallic aggregate, featuring spinifex-type quench textures (Figs. 12, 13) and fused porphyritic segregations of native iron.

Mineralogical composition (in %): olivine (elongated blades – laths) – 45–60%; matrix (grey phase): Fe-Al-Si phase – ~50%, Ti-Fe skeletal crystals – up to 5%, native metallic iron – 0–5%.

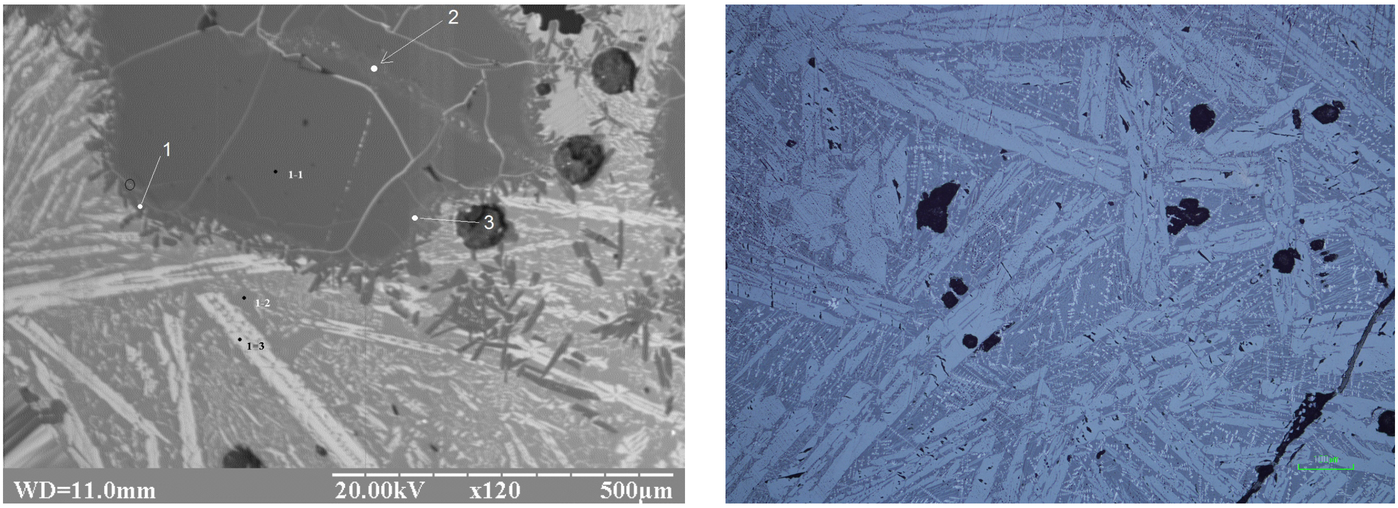


***Fig. 12.** Fragment of the silicate-metallic lava aggregate structure with spinifex-type quench textures and fused porphyritic segregations of native iron in pyroxenitic komatiites.*

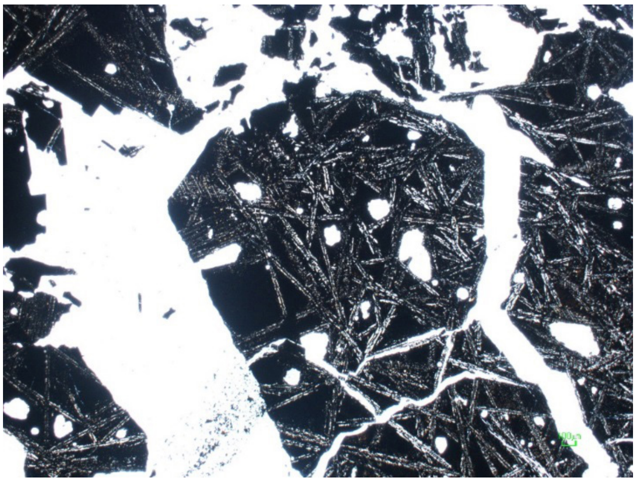
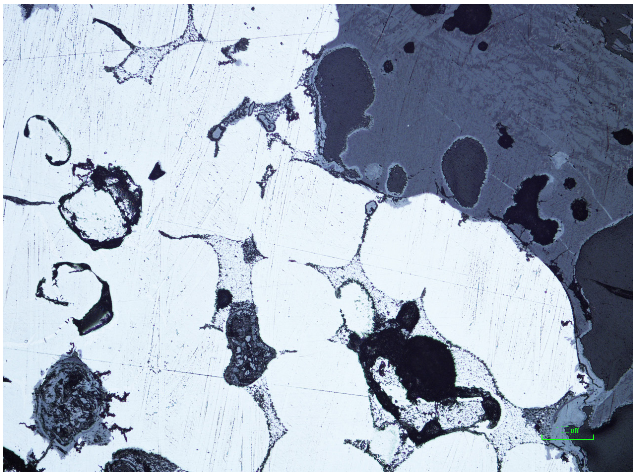


***Fig. 13.** Spinifex-textured (quenched) zone of a lava flow. Pyroxene-olivine skeletal quench structure. Objective 2x. Crossed nicols*



Bottom photo – native metallic iron.

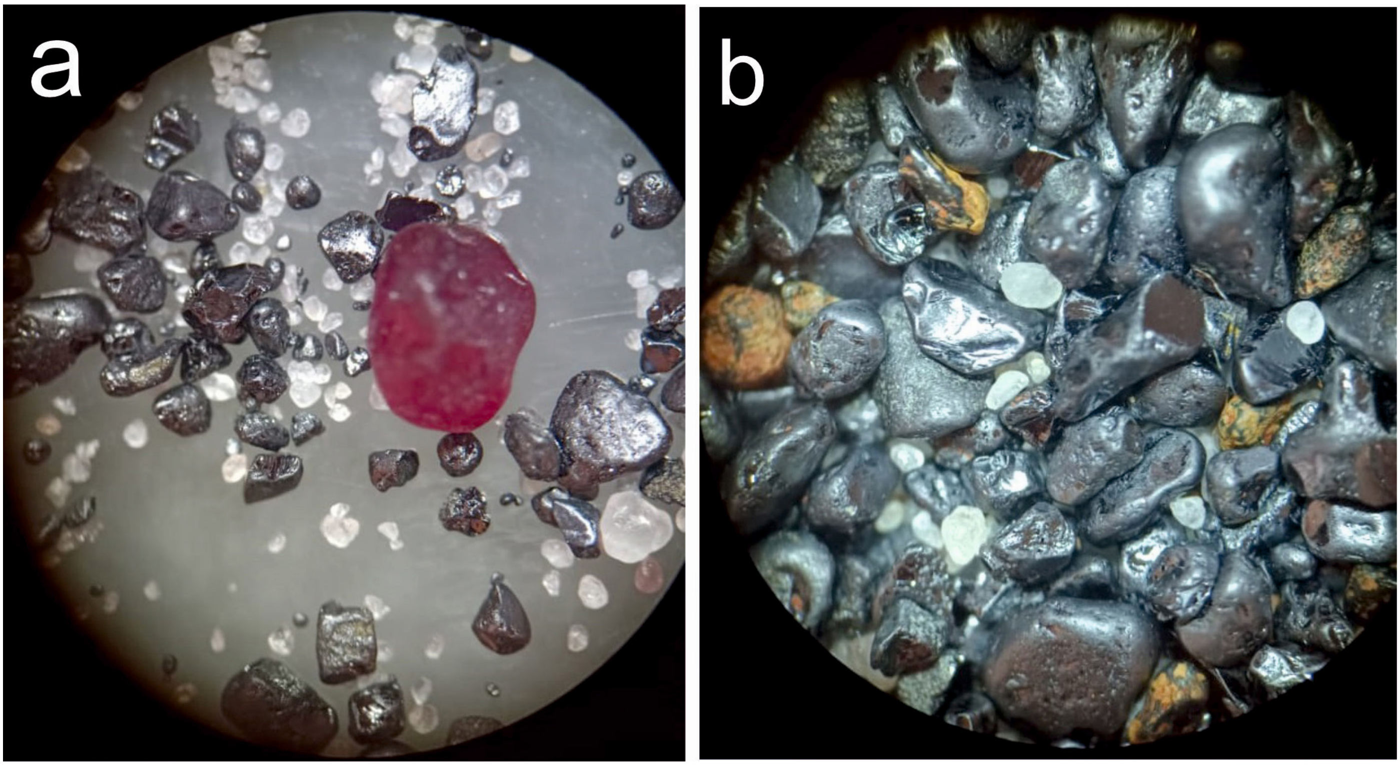


***Fig. 14.** Heavy mineral concentrates from kimberlite breccias (pyrope, chromite, picroilmenite).*

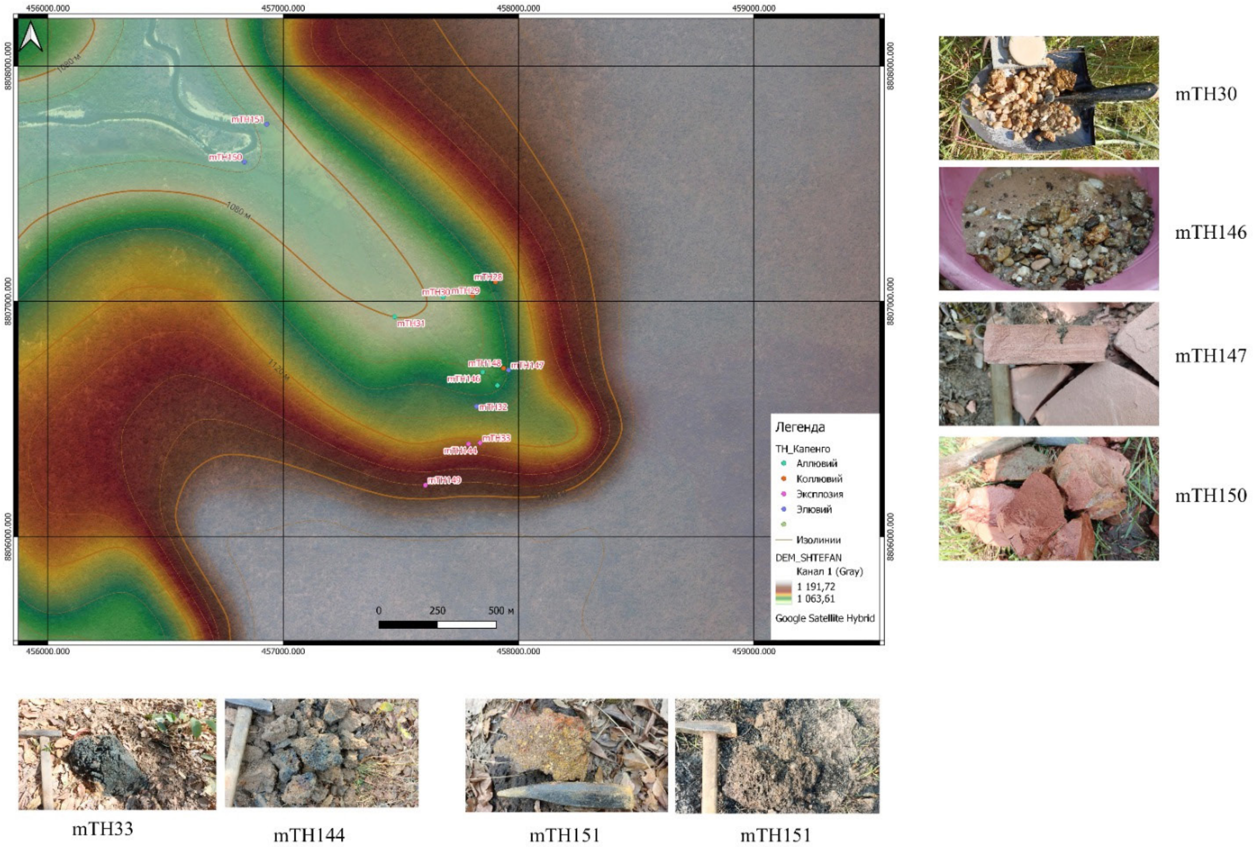


***Fig. 15.** Locations of lava-pyroclastic facies volcanic rocks associated with kimberlitoids.*

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