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Geology Development and Evaluation of Meya Kimberlite Dyke System, Kono District, Sierra Leone

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Introduction

Diamonds were first discovered in the Kono district of Sierra Leone at Monkey Hill, the location of the active Koidu mine, by the British Geological Survey in 1933. The Meya dyke system is part of the Koidu kimberlite cluster that extends for approximately 2.5 km west of the Koidu mining lease. This specific area of Kono is significant because at least five mega diamonds greater than 500 cts have been recovered. Four of the five mega diamonds were discovered by small-scale artisanal miners focused on washing alluvial material; however, the 476 ct Type IIa Meya Prosperity (originally > 500 cts - broken during recovery) was recovered during bulk sampling of the Meya kimberlite system in 2017. Kimberlite dyke evaluation is more challenging in comparison to kimberlite pipe evaluation. The approach taken for the 3D geology and resource development of the Meya dyke system will be presented in this contribution.

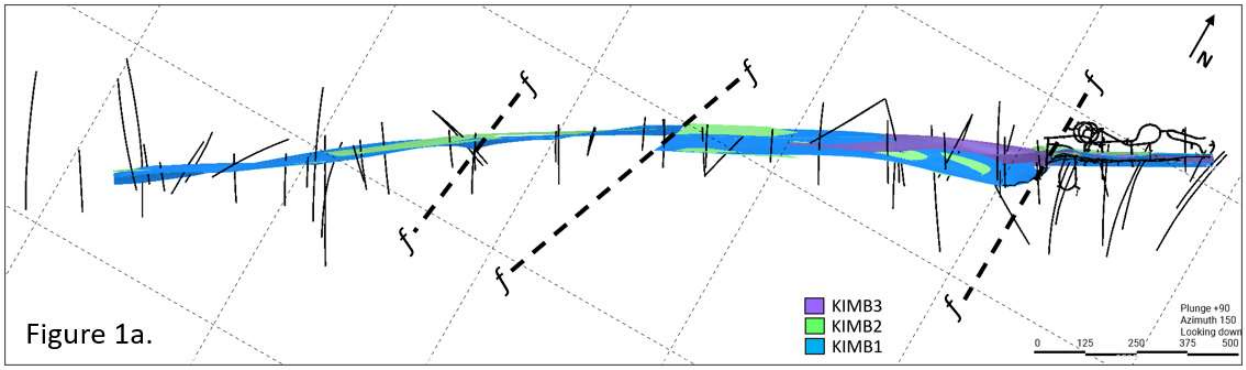
Geology

The Meya dyke system (Fig. 1), located immediately west of the Koidu Mine, is a series of near-vertical dykes that strike ENE-WSW at approximately 60 degrees. The Meya dykes were emplaced between 143+/-1-146+/-3 Ma within an Archean granitoid terrain (Skinner et al., 2004), (Moss et al., 2012). Meya is one of sixteen potential dyke occurrences within a swarm of kimberlite dykes in the Kono district, occurring within a 19 x14 km area. Meya represents the on-strike extension of Dyke Zone B (DZB), which is currently in production at the Koidu mine. Many of the kimberlite dykes within Kono are sub-vertical in orientation and range in thickness from a few centimetres to 80 cm in width, with thicker portions present that are typically not continuous for more than a few hundred meters along strike. Meya is unique in that there are multiple locations along the dyke where the thickness is greater than 1 m, with a maximum of 2.3 m thickness. Meya is referred to as a “system” of dykes because there are at least three dominant dykes, or phases, of en-echelon kimberlite present, which possess unique petrographic features. The three individual phases include KIMB1, KIMB2, and KIMB3 that are characterized by different olivine populations, mantle-derived indicator minerals, groundmass mineral populations, country rock xenoliths, and, most importantly, diamond grades. One unique feature of KIMB3 is the presence of abundant basalt xenoliths, including vesicular examples, interpreted to represent long-eroded country rock that was present at the time of emplacement.

Geological Development and Sampling

It is important to appreciate that the location of the Meya dyke system, and the adjoining Bardu and Waterloo systems that extend for approximately 10 km west of the Koidu mining lease, were discovered and initially mined close to the surface by small-scale artisanal miners. The trace of the 10 km long system can be seen on Google Earth, and this was used to guide and direct the initial delineation drilling of the dykes for 10 km using 500 m spaced centers with angled holes drilled perpendicular to the strike of the dyke. No previous drilling or geophysics was used to determine the collar locations. The artisanal mining

activity throughout Kono and other areas within Sierra Leone is an extremely valuable tool for locating kimberlites. Multiple phases of core delineation drilling were undertaken to determine the dyke location, thickness, number of dyke segments, and phases present. HQ diameter core was prioritized. In addition to drillcore investigations, a bulk sample pit ~250 m in length was excavated and mapped in detail at multiple elevations, providing excellent exposure to the dyke. More than 7000 carats of macrodiamonds for grade and diamond value were recovered from the bulk sample. Underground mining exposures were mapped, and additional material from the underground was available for geological sampling. Geological samples comprise representative petrographic and microdiamond samples from the dominant kimberlite types present. Drillcore logging, petrographic investigations, spinel compositions, microdiamonds, and production data were used to establish and confirm the presence of different phases of kimberlite. The key petrographic features distinguishing these rock types are presented in Fig. 2 below.



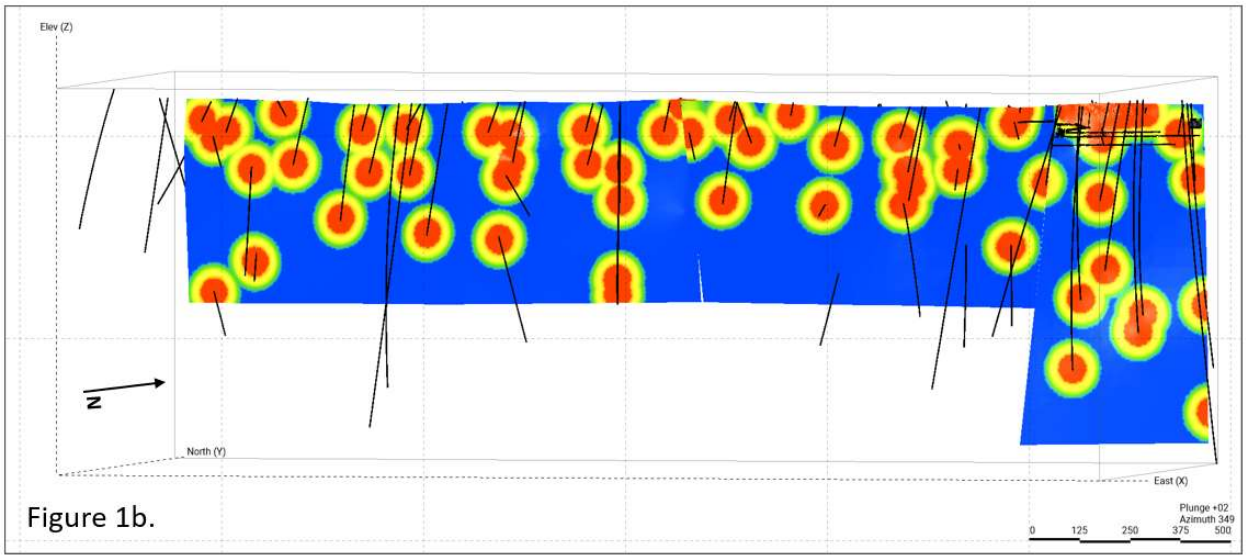


Figure 1a: Plan view of the Meya dyke system comprised of three phases of kimberlite: KIMB1, KIMB2, and KIMB3. Drillhole traces are shown in black, and underground mining infrastructure is shown to the left of the eastern fault. **1b:** Vertical sections of the Meya dyke KIMB1 showing drillcore pierce point contours with a diameter of 150 m.

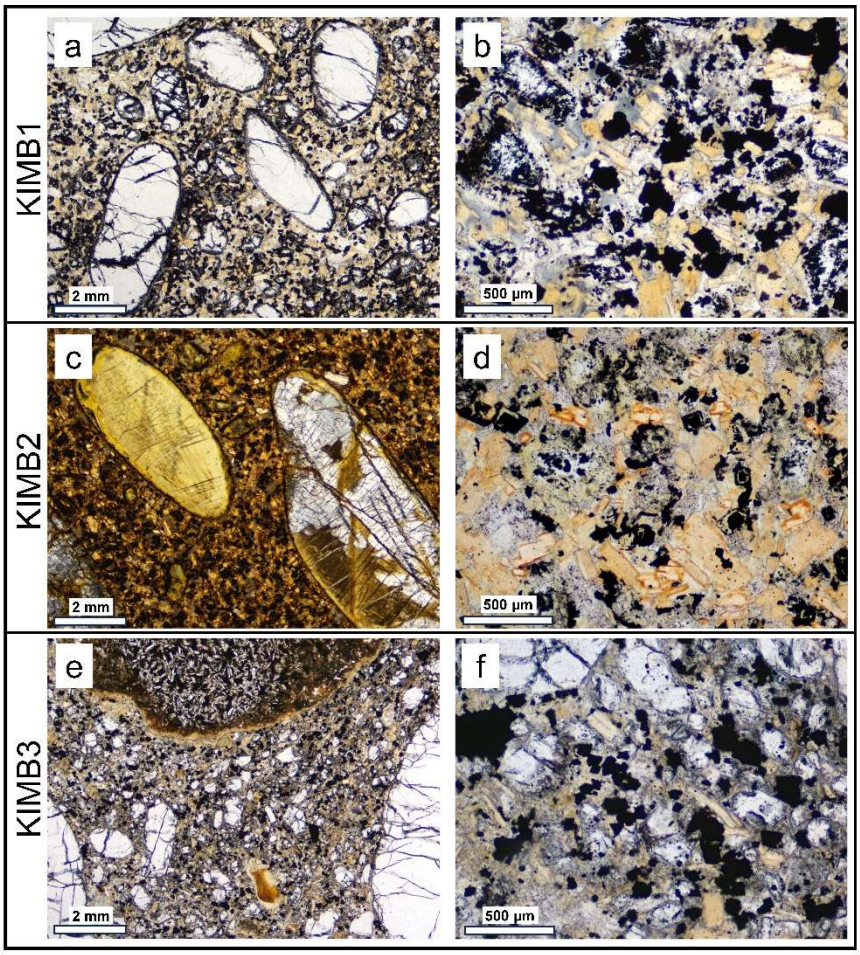


Figure 2: Representative photomicrographs of Meya rock types in plane polarized light. **KIMB1**. a) Fresh olivine macrocrysts (OLVm) with distinctive opaque oxide replacement on rims/fractures. b) Groundmass with fine-grained opaque oxides on olivine rims, grey "glassy" serpentine (SER) with small/stubby phlogopite (PHL), and clustering of spinel. **KIMB2**. c) Note the high % of PHL and talc replacing OLVm. d) Groundmass with distinctive atoll SPN and zoned PHL. **KIMB3**. e) Note the basalt xenolith, a key feature of this rock type, and the high % of fine-grained olivine phenocrysts and extensively fractured OLVm. f) The groundmass contains distinctive thin, elongated PHL crystals.

Conclusions

The Meya dyke system contains significant quantities of high-value diamonds (>300 USD/ct), including Type IIa mega diamonds above 500 carats. Multiple phases of kimberlite are present within the system. The morphology of the dykes and continuity of geology within the dykes with respect to the juvenile components can be highly variable. Currently, underground mining by long-hole open-stoping methods is underway on the far eastern portion of the dyke, close to the boundary with the Koidu Mine. In addition, deep core drilling targeting the dyke 500 m below the surface is in progress for the purpose of resource development at depth. The results of this work will be presented in a preliminary economic assessment (PEA) report later this year.

References

Moss, S., Nowicki, T., Hetman, C., Freeman, L., & Abedu, B. (2012). Geology and evaluation of kimberlite dykes at Koidu, Sierra Leone. *International Kimberlite Conference: Extended Abstracts, 10*. https://doi.org/10.29173/ikc3771

Skinner, E.M.W., Apter, D.B., Morelli, C. and Smithson, N.K., (2004). Kimberlites of the Man craton, West Africa. Lithos, 76(1-4): 233-259.