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Mineralogical Features and Comparisons of Diamonds from Three Kimberlite Belts in Mengyin, China

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Introduction

Diamondiferous kimberlites with industrial value in China are merely produced in Mengyin of Shandong province and Wafangdian (also named Fuxian) of Liaoning Province. Both deposits occur in the eastern part of the North China Craton (Liu et al., 2019). The diamondiferous kimberlite cluster in Mengyin, including Changmazhuang, Xiyu and Poli kimberlitic belts, is an important production area of diamonds in China (Wu et al., 2022). There are significant differences in kimberlitic mineralization, lithological assemblage, various degrees of carbonation, crystal color, grain size, morphological and surface features and inclusion of diamonds in the three belts (Lv et al., 2022; Zhang et al., 2022). The Shengli I kimberlite pipe in Changmazhuang belt, as the richest diamond mine in the Mengyin deposit, produces high-grade diamonds and high-value brown diamonds (Wu et al., 2022). In contrast, the Poli diamondiferous kimberlite belt has not found industrial value diamonds. It is ambiguous whether the formation stages and origin mantle in depth, temperature and pressure crystallization condition of diamonds in the three belts are different. Therefore, we systematically summarize and mineralogically compare previous data of more than 100,000 diamond grains related to the three belts from geological survey reports and references (Lv et al., 2022).

Spatial Distribution of Three Diamondiferous kimberlite Belts in Mengyin

The Mengyin diamondiferous kimberlites crop out within the Shandong peninsula, which is part of the Hebei–Shandong–Liaoning continental core in the eastern part of the North China Craton (Figure 1a). The Mengyin diamonds are produced from Early Paleozoic kimberlite, and are located in the area about 60–70 km west of Tancheng-Lujiang fault (Figure 1b). The Mengyin deposit consists of Changmazhuang, Xiyu and Poli kimberlite belts from SW to NE (Figure 1c). The overall striking of the deposit is about NNE 55°, with a length of about 55 km and a width of 15 km in total. There are 10 pipes, 47 dikes and one sill in the three belts. The wall-rocks are briefly composed of Neoarchean Trondhjemite-Tonalite-Granodiorite-like gneiss and Neoarchean Taishan Group strata, Paleoproterozoic intrusive rocks and minor Cambrian limestone (Ni et al., 2020). In a panoramic view, they are characterized by a trend of spreading to the north and converging to the south (Zhang et al., 2022). The Changmazhuang belt is located in the west of Changma village, about 13km southwest of Mengyin County, with a total strike of NW 345°, a length of about 14 km and a width of 2.5 km (Figure 1c). It consists of eight kimberlite dikes and two pipes, eight of which are of industrial grade, and among which Shengli I pipe contains the highest grade value of diamond. The Xiyu belt is located near Xiyu village, about 12 km north of Mengyin County, with a total strike of about 15°, a length of about 12 km and a width of 0.5–1 km. It is composed of 24 kimberlite bodies, of which 17 are of industrial grade. The Poli belt is located in Yedian–Poli–

Jinxingtou area of Daigu town, 30 km northeast of Mengyin County with a total strike of about NE 35°–45°, a length of about 18 km and a width of about 0.6 km. It consists of 25 dikes, no pipes, poor ore-bearing properties and no bodies reaching industrial grade (Song et al., 2020; Zhang et al., 2022).

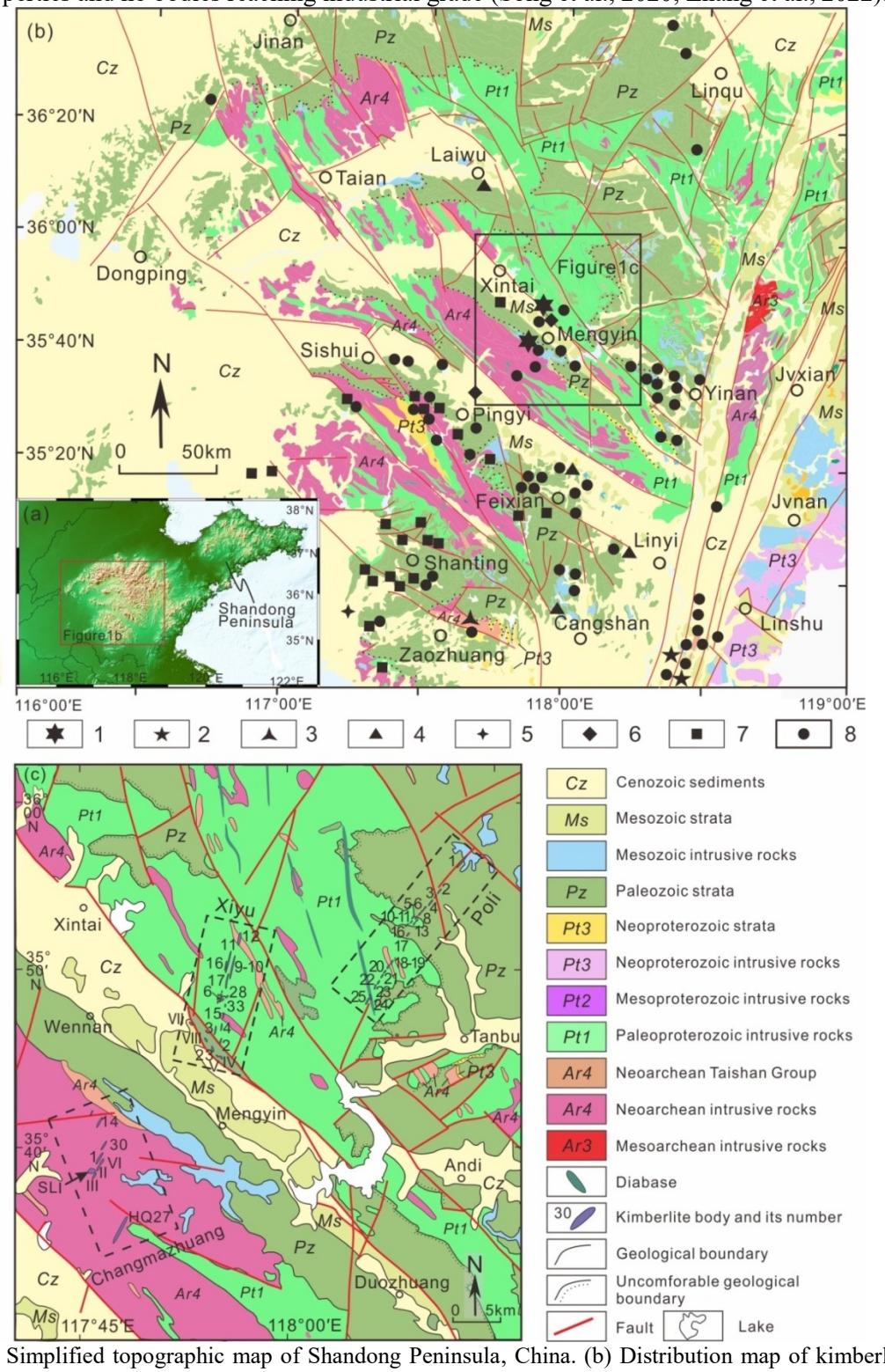

Figure 1 (a) Simplified topographic map of Shandong Peninsula, China. (b) Distribution map of kimberlite-hosted diamonds and alluvial rocks-derived diamonds in Mengyin, Shandong Province. 1-kimberlite-hosted diamond; 2-Alluvial diamond; 3-Diamond-bearing conglomerate in Cambrian Liguan Formation; 4-Diamond-bearing

conglomerate in Carboniferous Benxi Formation; 5-Diamond-bearing conglomerate in Jurassic Sanhe Formation; 6-Diamond-bearing conglomerate in Paleogene Gucheng Formation; 7-Diamond-bearing conglomerate in Neogene-Quaternary Baiyan Formation; 8-Diamond-bearing Quaternary conglomerate; (c) Geological map of diamonds hosted in the Changmazhuang, Xiyu and Poli kimberlite belts in Mengyin deposit (Zhang et al., 2022). Greek numbers I, II, III and VI in the Changmazhuang belt and IV, V, VII and VIII in the Xiyu belt should be preceded by Shengli (means victory, SL in short) as SL I–VIII; Roman numbers 1–30 in the two belts should be preceded by Hongqi (means red flag, HQ in short) as HQ1–30; Roman numbers 1–25 in the Poli belt should be preceded by K as K1–25 to number kimberlite bodies.

Results

The results show that the crystal color, grain size, morphological features and inclusions of three-belt-diamonds are obviously different as follows: (1) The 51,484 diamond grains from the Changmazhuang kimberlite belt are mainly light yellow in color, followed by colorless and light yellow-brown, the highest proportion of grain-size ranges from 0.5 to 2.0 mm, and more than 7% over 2.0 mm. The 53,108 diamond grains from the Xiyu kimberlite belt are briefly colorless, followed by light yellow and brown in color, their grain sizes of 0.5~1.0 mm are accounted for the highest proportion, and the proportion of over 2.0 mm is about 4%. While 405 diamond grains from the Poli kimberlite belt are dominantly colorless followed by light yellow, all grain sizes are less than 1 mm. (2) Dodecahedron form is dominant in 4807 Changmazhuang diamond grains, morphologically followed by octahedron, glomerocryst of octahedron and dodecahedron. Single crystals account for about 85%. By contrast, octahedron is main morphological form in the 2479 Xiyu diamonds, followed by curved dodecahedron. The glomerocryst samples are accounted for about 30%. While the 405 Poli diamonds are dominated by single crystal-stepped octahedron. (3) The most complexed dissolution and resorption are displayed in 4807 Changmazhuang diamonds, including serrate, triangular pit, quadrilateral pit, hexagonal pit, laminae, imbricated etch, beam halo, dissolution pore, dissolution ditch and glide-plane. While the proportion of growth mounds, inverted triangular pits and laminae is relatively much higher in the 2479 Xiyu diamonds. Comparably, the 405 Poli diamonds mainly develop triangular pits, growth steps and growth hills. Diamonds in the three belts exhibit uniform pre–kimberlite surface features of multiple serrate, triangular laminae and small trigons, suggesting a similar condition of diamond destructive metasomatism caused by carbonatitic and silicate-carbonatitic melts. However, Poli diamonds probably suffered from a silicate component-enriched carbonatitic melt in the deep mantle. (4) Based on the Raman displacement data of olivine inclusions from Xiyu and Changmazhuang diamonds, the source pressures are calculated to be 5.09GPa and 5.26GPa, forming cratonic mantle with depth of 168 km and 174 km, respectively. The formation temperature is 1118–1251℃ for Changmazhuang diamonds, 1091–1167℃ for Xiyu diamonds, and 1132–1172℃ for Poli diamonds.

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