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Update on diamond mining in the Martapura area, South Kalimantan, Indonesia

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The enriched Zn content of the spinel host is consistent with the presence of wurtzite, of which Zn is a major element. To the authors' knowledge, this is the first time wurtzite has been reported as an inclusion in spinel from the Mogok area. This discovery contributes to the geographic-origin determination of spinel and expands our knowledge of the micro-world of Mogok spinel.

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DIAMONDS

Update on Diamond Mining in the Martapura Area, South Kalimantan, Indonesia

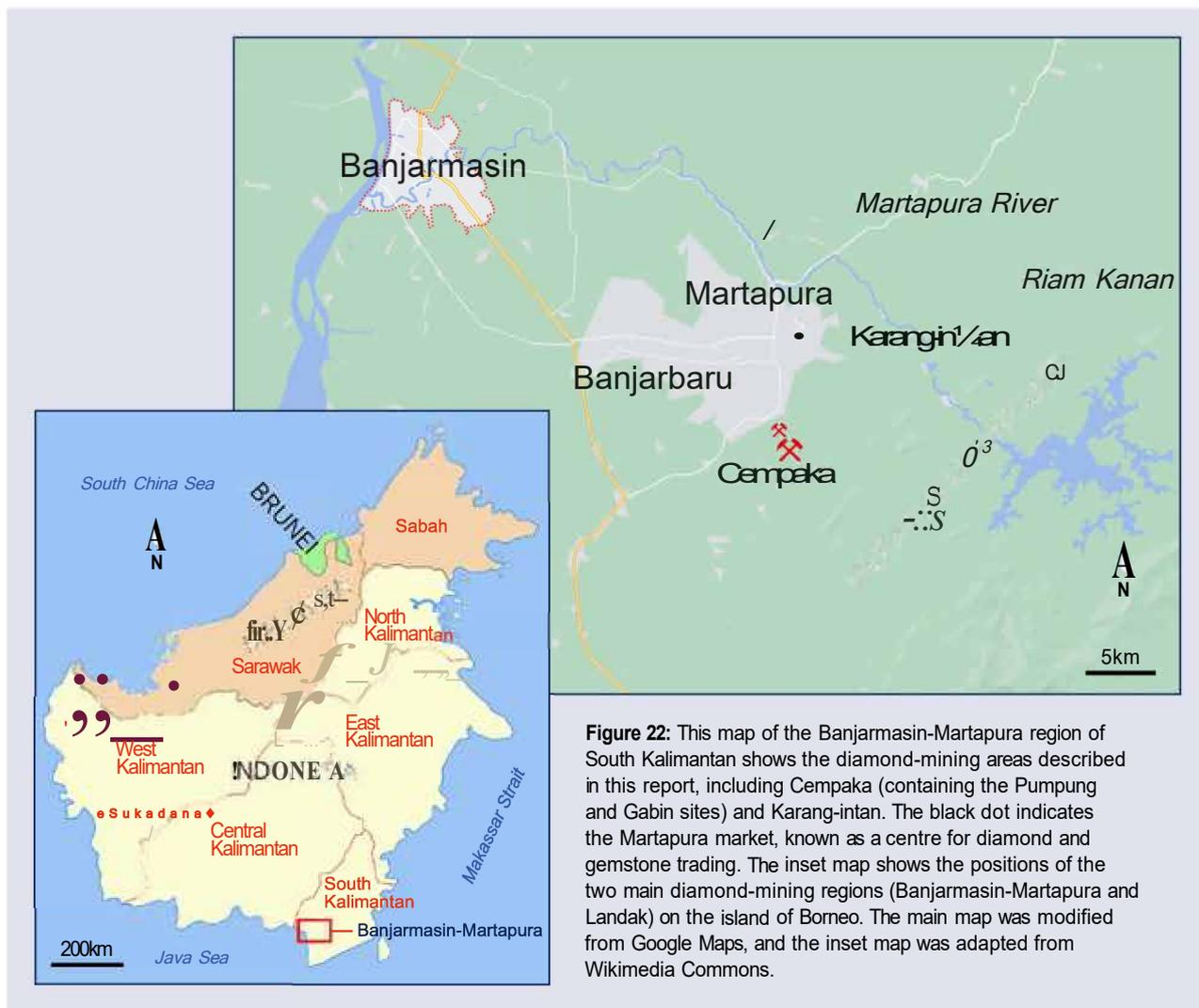
On 5-10 August 2024, author TTS organised a field trip for eight persons (including authors JCZ and LHY) to the Martapura diamond-mining area in southern Indonesia. The trip was guided by author NAN and Raditya Fitrianoor Putra. A recent article in *The Journal* on the history and properties of the Banjarmasin diamond (van Leeuwen & Zwaan 2023) had stirred our interest to learn more about the current status of diamond mining in that area, which is located on the island of Borneo about 20 km south-east of Banjarmasin city near Banjarbaru, the capital city of South Kalimantan Province (Figure 22). Diamonds have been found in alluvial deposits of the Banjarmasin-Martapura area since around 600 CE (Webster 1983).

One of the most well known diamond-mining localities in the region is Cempaka. This area is characterised by (sub)recent alluvial deposits composed of sandstone, gravel, silt, clay and mud, which are weathered from the adjacent Meratus Mountains. The uplift of these mountains occurred during the Plio-Pleistocene period (ca. 5-1 million years ago [Ma]), giving rise to the emplacement of an older ophiolite body containing pyroxenite (Kueter *et al.* 2016). Most of the diamonds in this region have been recovered from the youngest alluvial deposits (<1 Ma), although rivers draining Late Cretaceous conglomerates (part of the Manunggul Formation), located in the central to northern part of the southern Meratus Mountains, are also known as diamond bearing.

At Cempaka's Pumpung site, mining activities had slowed since author TTS visited there in 2002 (Tay *et al.* 2005), in part due to COVID-19, and also because of heavy rainfall that flooded many of the mining pits in 2022 and 2023. Today, workers must dig 10-15 m to reach the diamond-bearing layer. At the time of our visit, only one mining pit was in operation (Figure 23a). Slurry from the pit was pumped into a wooden sluice tower, and the concentrate was then hand-washed using a wooden pan called a *dulang* (Figure 23b). The pan is spun to help remove small pebbles while allowing the heavy sediments to concentrate in the centre, including any diamonds or gold particles.

At Gabin, just north of the Pumpung site, local villagers were seen washing gravels derived from a diamond-bearing horizon that is about 50-100 cm thick. This layer consisted of mixed sand, gravel and larger pebbles, and was clearly visible beneath an overlying finer sand layer and an underlying clay-rich horizon of the Plio-Pleistocene Dahor Formation. According to the locals, the largest diamond found at this site weighed 12 ct.

At Karang-intan, on a tributary of the Martapura River (Riam Kanan), we saw about 15 small barges that employed vacuum pumps to extract gravel from the river bed (e.g. Figure 24a). Two or three miners worked in conjunction with each barge, pumping the gravel into a sluice and doing the *dulang* washing. On some barges, the use of ropes attached to winches suggested



deeper mining below the river bed. Occasionally, boats were seen carrying away piles of sluiced gravel to be washed and sorted for diamonds (Figure 24b). The location, setting and composition of the gravel, which contained much more volcanic components compared

to the sediments at the Pumpung site, suggested that sediments derived from the older Manunggal Formation were being mined there.

Most rough diamonds we were shown by workers at the Pumpung site reportedly came from both the



Figure 23: At the Pumpung site, diamonds are recovered from recent alluvial deposits (a) using a tall wooden sluice tower and (b) by hand-washing with a *dulang* pan. Photos by J. C. Zwaan.



Figure 24: (a) On a tributary of the Martapura River (Riam Kanan) at Karang-intan, diamond mining is done using several barges. Gravels from the river bed are pumped into sluices, and then the concentrate undergoes du/angwashing. (b) Boats are used to transport the sluiced gravels elsewhere for further washing and extraction of diamonds. Photos by (a) Tay Thye Sun and (b) J.C. Zwaan.

Cempaka and Karang-intan areas. The gem-quality crystals we saw varied in shape, but many showed symmetrical to distorted octahedral habits with rounded edges, as well as octahedral/dodecahedral crystals and an occasional macle. Their colours ranged from colourless to yellowish or brownish (Figure 25a). At Gabin, we were shown some brown and slightly greenish brown crystals, some of which were intensively resorbed (Figure 25b). Many of the crystals had a shiny surface, resembling chemical polishing. These characteristics are all consistent with earlier descriptions of Kalimantan diamonds (e.g. Smith *et al.* 2009). Author TTS purchased a 14.95

carat parcel of small rough diamonds from a local miner, who had obtained them from the Cempaka, Karang-intan and Landak areas over the past several years (Figure 25c). In addition to octahedra, rhombic dodecahedra and macles, the parcel contained four interpenetrating twins (see front row in Figure 25c).

The Banjarbaru diamond-mining region is encompassed by the Meratus Geopark (established in 2018). As diamond mining has long been part of the culture in South Kalimantan, the local government has incorporated it into the Geopark to encourage ecotourism. The recently built Cempaka diamond-mining museum emphasises the uniqueness and value of diamonds



Figure 25: (a) Some of the larger diamond crystals seen from the Pumpung site are these two octahedra (each slightly below 3 ct) and a 3.22 ct macle (centre). (b) These resorbed diamond crystals from the Gabin site range from colourless to (greenish) brown, and are estimated to weigh slightly more than 1 ct each. (c) A parcel of small diamonds (total weight 14.95 carats) purchased from a local miner contains octahedra, rhombic dodecahedra, macles and interpenetrating twins (the last are visible in the front row, weighing 0.14-0.40 ct). Photos by (a, b) J. C. Zwaan and (c) Tay Thye Sun.

in this area from the perspective of the local Banjar and Dayak tribes, while also highlighting the area's geology, flora and fauna. It is hoped that the Geopark initiative will help empower the local community to improve the welfare of its people and keep its economy sustainable.

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TREATMENTS

Green Sapphires Treated by Beryllium Diffusion on the Bangkok Market

Since the early 2000s, sapphires and rubies have been treated by Be diffusion, and this process can yield gem corundum in a variety of colours, including green (Emmett *et al.* 2003). Recently, Guild Gem Laboratories examined ten green sapphires (Figure 26) that were reportedly diffusion treated using another light element-Li-which had been offered on the gem market in Bangkok, Thailand. Standard gemmological testing confirmed the stones as corundum,

according to their RIs of 1.761-1.770 and their FTIR spectra. All of the samples were inert to long- and short-wave UV radiation.

Microscopic observation revealed features indicative of high-temperature heat treatment, such as severely expanded fluid inclusions and blue spots corresponding to internal diffusion (Figure 27). Also present were solid inclusions with a melted appearance (Figure 28), which were identified by Raman

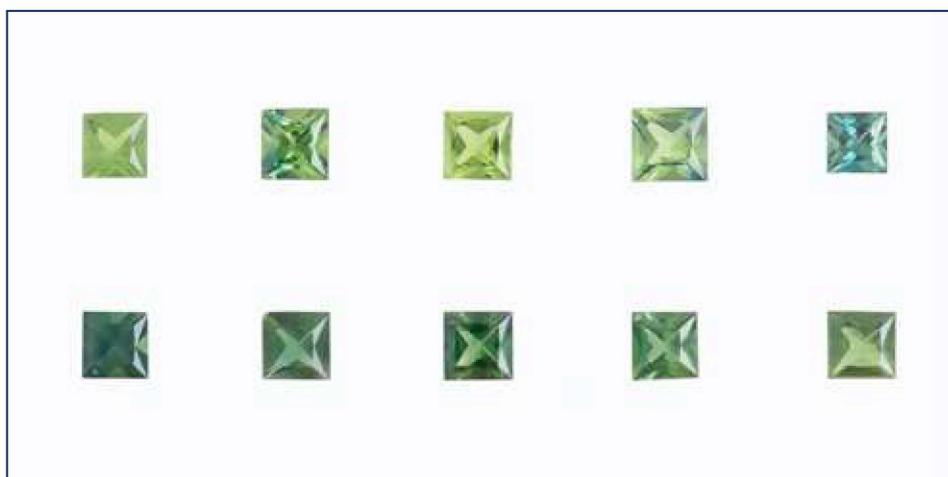


Figure 26: These ten green sapphires (0.30-0.50 ct), obtained on the Bangkok gem market, were claimed to have been Li diffused, but proved to have been treated with Be. Composite photo by Siqi Luo