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EPMA study of heavy minerals in the Annah Rais-Bayur area, Sarawak

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Abstract: The EPMA technique is applied in the geochemical exploration for heavy minerals in stream sediments in the Annah Rais-Bayur area in Sarawak. The rivers sampled include Sg. Semadang, Sg. Tebia, Sg. Abang O, Sg. Nibong and Sg. Temurang.

Among the five rivers draining the area, it was found that ilmenite and rutile were present in all the rivers sampled with higher concentrations in Sg. Semadang and Sg. Tebia. Zircon and monazite were also found in all the rivers but with higher concentrations in Sg. Abang O and Sg. Tebia. Cassiterite was found in Sg. Nibong and Sg. Tebia while cinnabar was found in Sg. Temurang. More importantly, gold was also found in Sg. Nibong, Sg. Tebia and Sg. Abang O.

The Annah Rais-Bayur area has good potential for economic mineral resources in particular Au, Sn, Ti and Hg. More intensive geochemical exploration is recommended to delineate the source areas of the minerals of economic potential.

INTRODUCTION

The Annah Rais-Bayur area is in the Ulu Penrissen area in the western part of Sarawak (Fig. 1). The geology of the area includes the Serian Volcanics, the Bau Limestone, the Pedawan Formation and the Plateau Sandstone Formation (Wilford & Kho, 1965).

This very area has contributed to the Sarawak economy in the 1800s through its many mineral resources.

The present study serves as a test for the use of the EPMA (electronprobe microanalyzer) as a tool in exploration geochemistry in the search for heavy minerals in stream sediments.

MATERIALS AND METHODS

Stream sediments were collected from the main rivers in the area, namely, Sg. Abang O, Sg. Temurang, Sg. Nibong, Sg. Tebia and Sg. Semadang.

Sg. Abang O drains the northern part of the area cutting through the Plateau Sandstone, the Bau Limestone and finally the Pedawan Formation. Sg. Temurang is south of Sg. Abang O and flows through the Bau Formation and Pedawan Formation. Sg. Nibong is in the central western part of the area and drains essentially through the lowlying part of the Pedawan Formation. Sg. Tebia is on the central eastern part of the area draining down from the mountainous Plateau Sandstone into the low-lying Pedawan Formation. Sg. Semadang is the main river in the area, flowing from south to north cutting through the Pedawan Formation in the low-lying central part of the area. All the earlier rivers empty into the Sg. Samadang at various locations.

The heavy minerals in the stream sediments were concentrated using a dulang. The final concentration involved the use of a small dulang made out of coconut shell. Each sample was then mounted in aradite and then polished.

The polished sample of the grains were studied on the Cameca SX100 Electronprobe Microanalyzer (EPMA) using the secondary electron (SE) image to study the morphology and texture of the grains while the backscattered electron (BSE) image was used to identify and differentiate the different heavy minerals present. The different heavy mineral contents were arrived at by point counting (Table 1) (Teh, 1999).

RESULTS AND DISCUSSION

The heavy minerals that were able to be separated following their compositions from X-ray mapping include ilmenite, rutile, iron oxide, zircon, monazite, xenotime, augite, tourmaline, hercynite, cassiterite, cinnabar and native gold.

Hercynite ($Fe^{2+}Al_2O_4$), is cubic, and belongs to the spinel group (Fleischer, 1983) (Fig. 2).

The results show that each river sampled has its characteristic composition of heavy minerals. The 5 minerals, namely ilmenite, iron oxide, rutile, augite and tourmaline were found in all the samples panned and all the rivers sampled.

Ilmenite is present in all rivers sampled, with high concentrations in Sg. Semadang (30.43%), Sg. Tebia (29.03%), Sg. Abang O (24.76%) (Fig. 3). The mineral rutile is also present in all rivers sampled with the highest again in Sg. Semadang (37.27%), followed by Sg. Tebia (32.18%) and Sg. Nibong (23.47%).

Iron oxides are found in the rivers where both ilmenite and rutile are found, the highest in Sg. Nibong (17.35%) followed by Sg. Tebia (11.34%) and Sg. Temurang (10.96%).

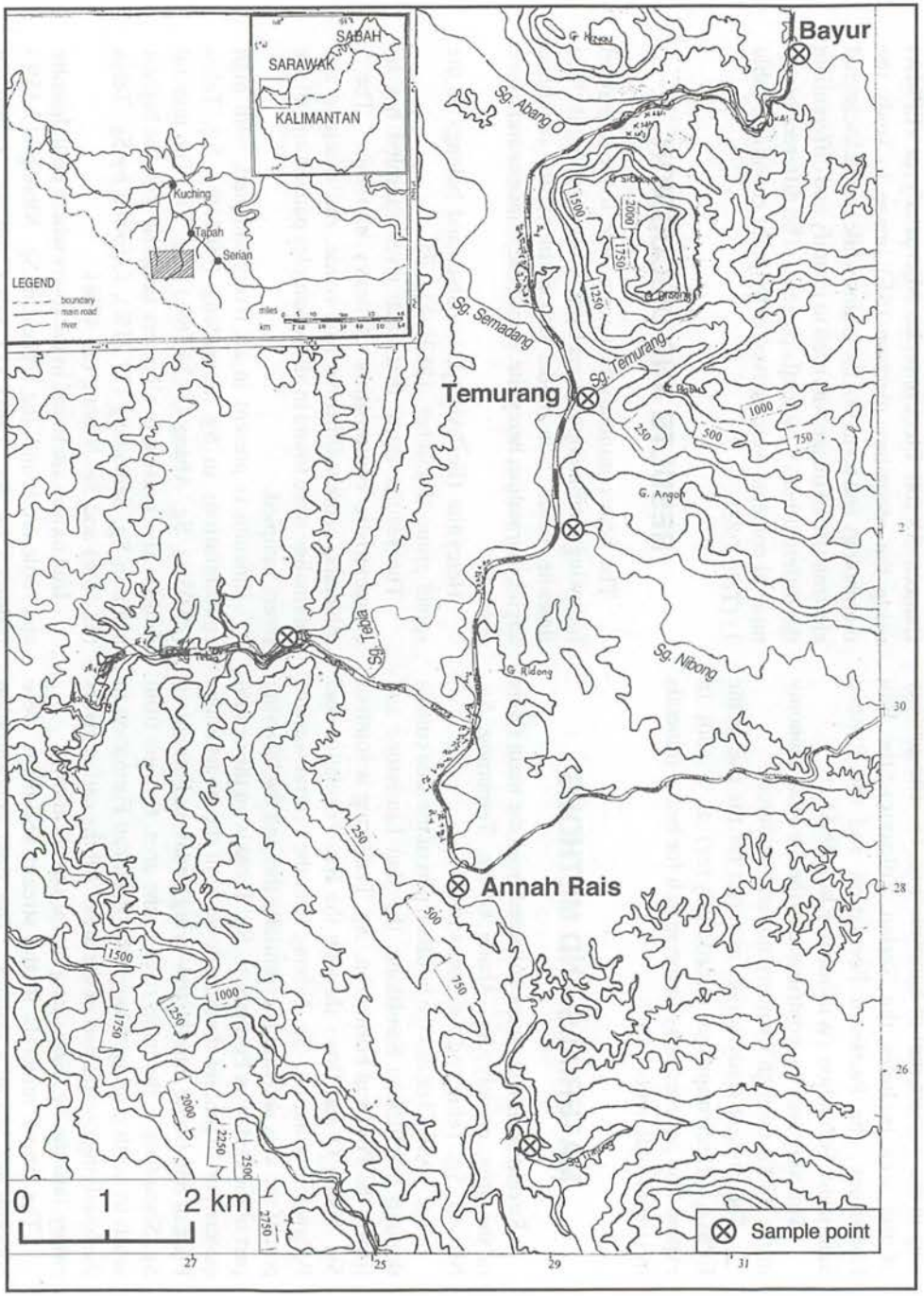

Figure 1. Location map of the Annak Rais-Bayur area showing sample locations.

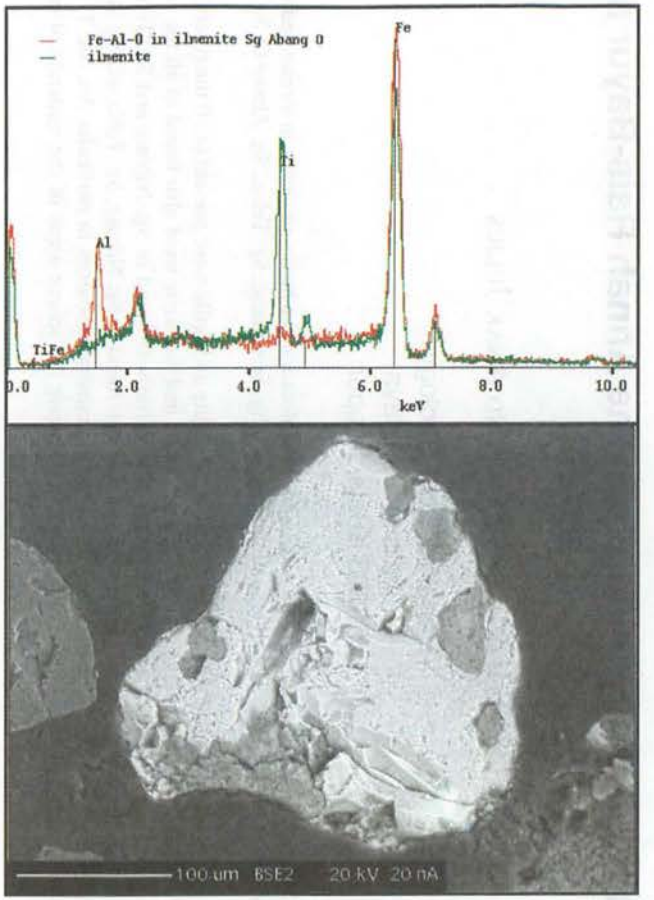

Figure 2. Mineral grains of hercynite ($Fe^{2+}Al_2O_4$) (grey) in ilmenite (light grey). EDS scan above confirms composition of hercynite (red) and ilmenite (green).

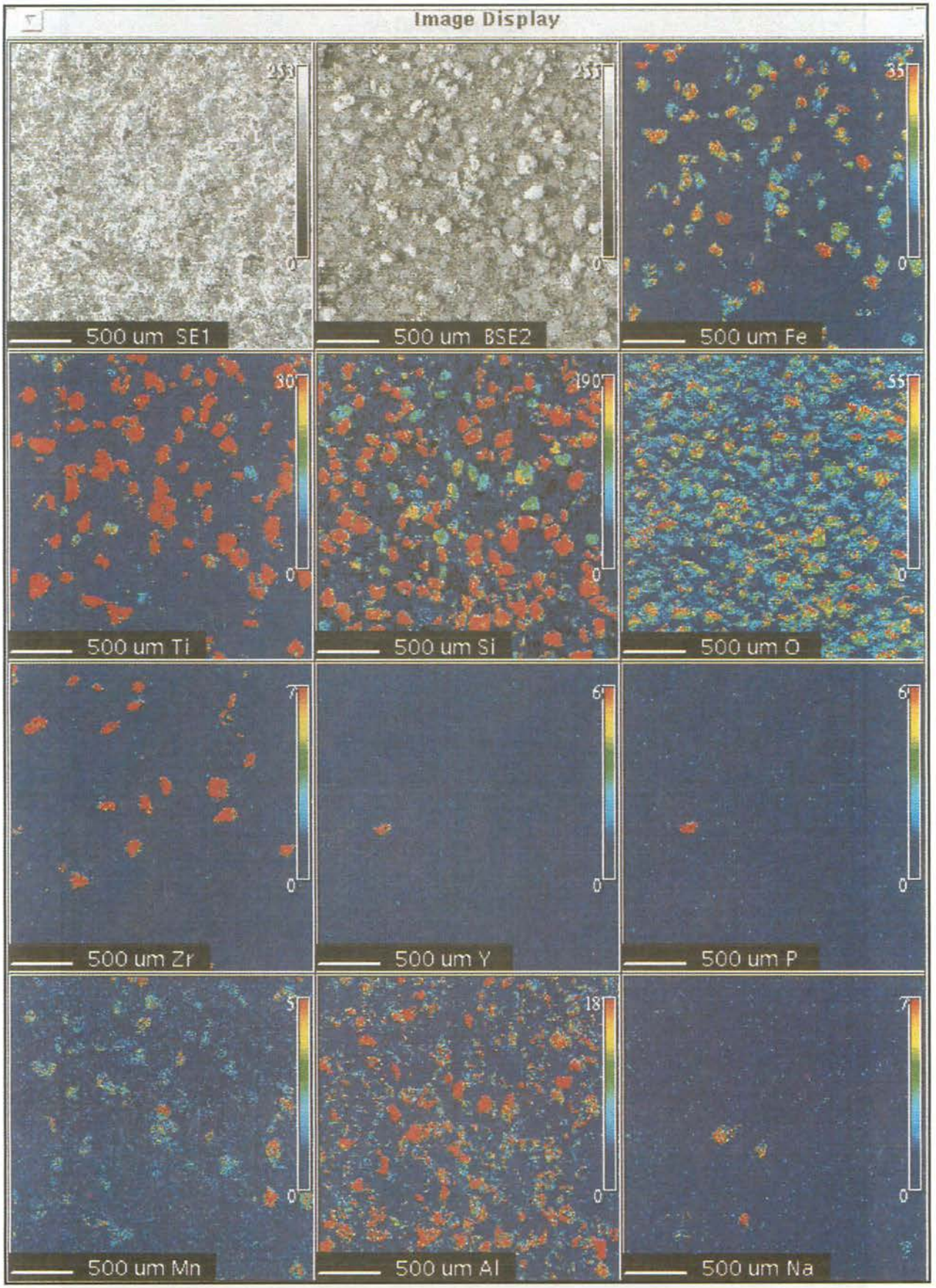

Figure 3. X-ray map of heavy minerals in Sg. Semadang showing abundant ilmenite (Fe, Ti, O), some zircon (Zr, O) and a grain of xenotine (Y, P).

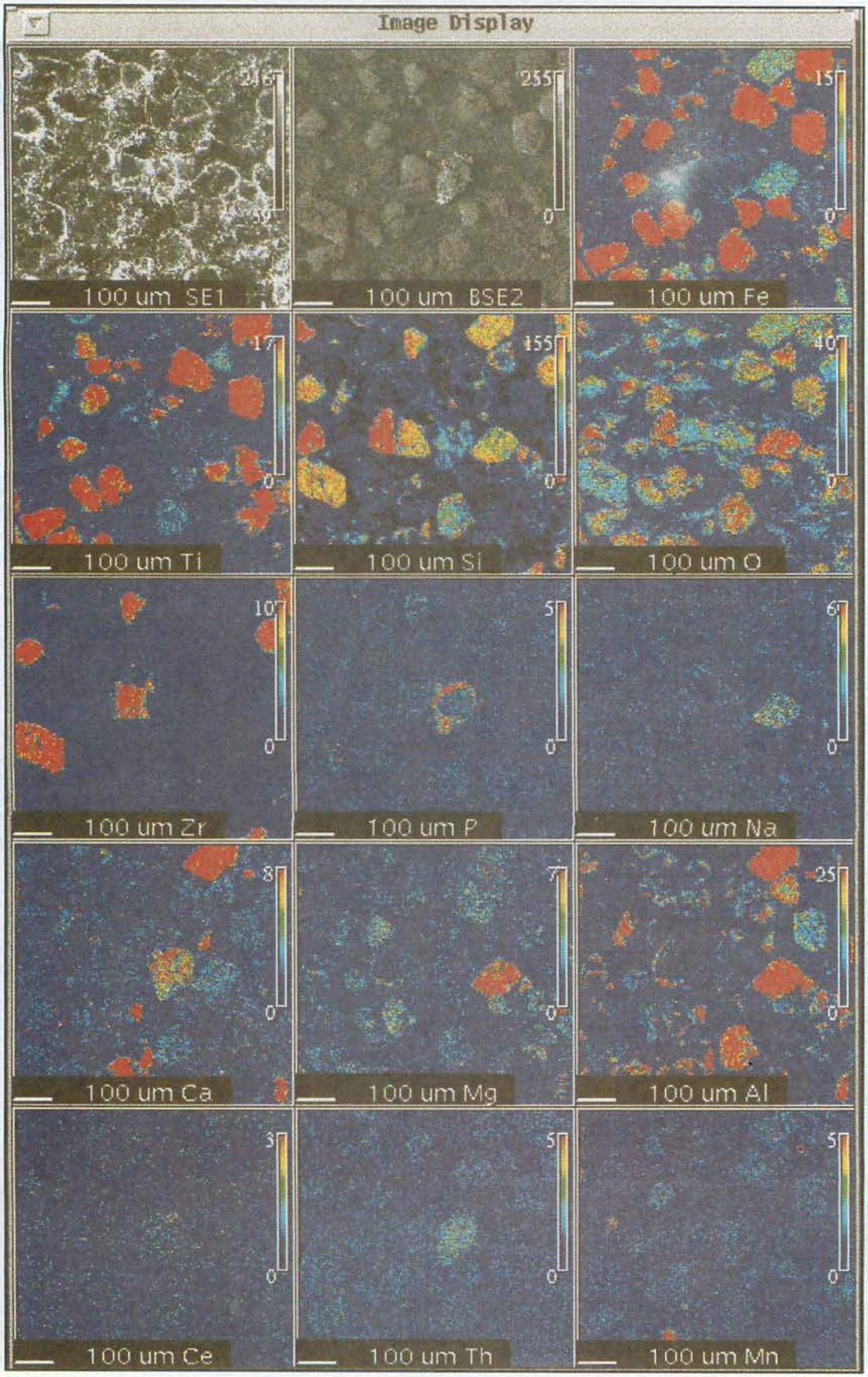

Figure 4. X-ray map of heavy minerals in Sg. Tebia showing abundant ilmenite and a monazite grain (Ce, Th, P).

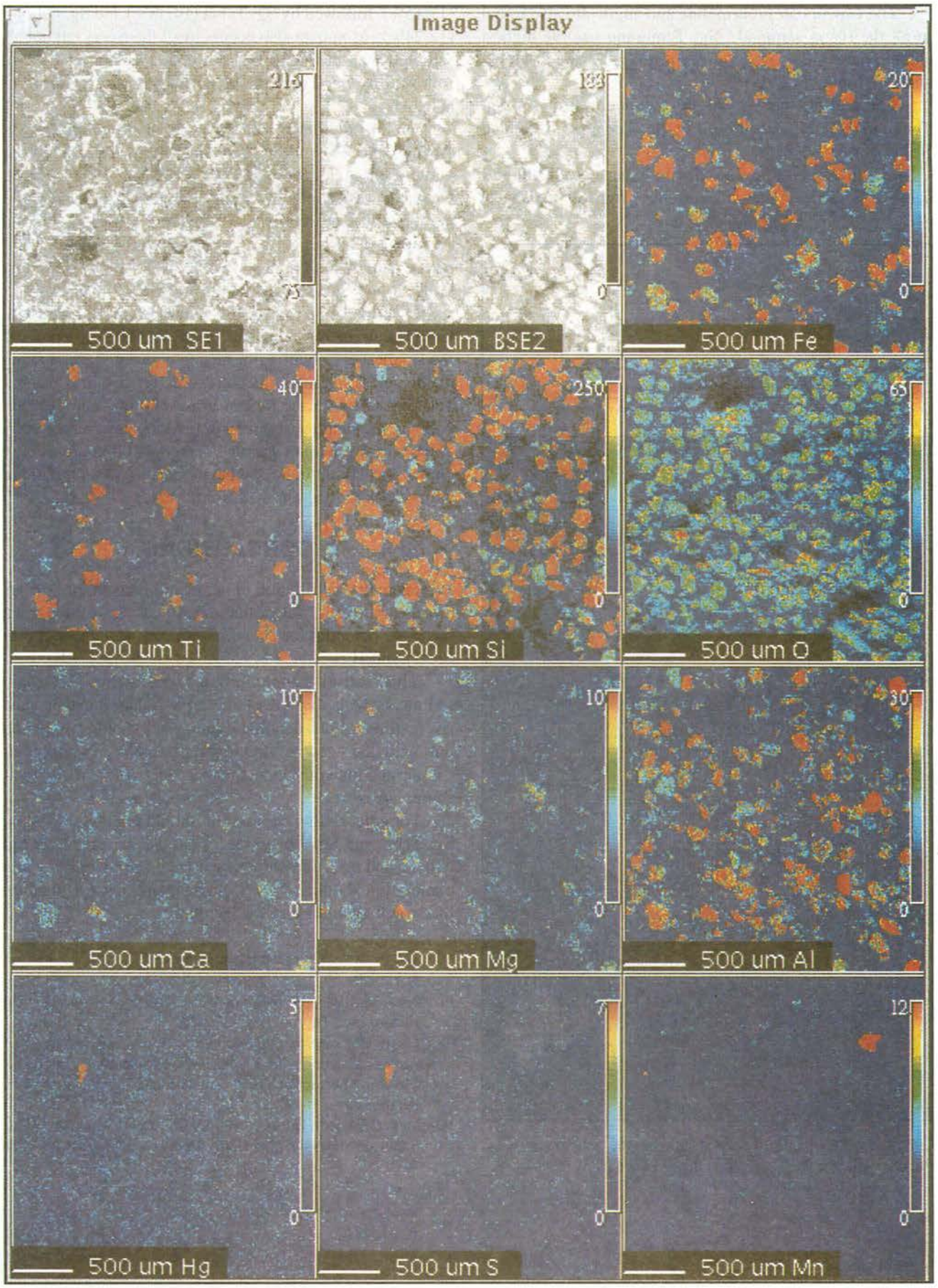

Figure 5. X-ray map of heavy minerals in Sg. Temurang showing the presence of cinnabar (Hg, S) and abundant silicates (Si, Al, O).

May 26–27 2002, Kota Bharu, Kelantan, Malaysia

The two silicates tourmaline and augite are also found in all the rivers sampled. Sg. Temurang has the highest augite content, 21.58%, followed by Sg. Abang O (16%) and Sg. Tebia (14.29%).

Tourmaline has the highest concentration in Sg. Temurang (27.27%), followed by Sg. Tebia (21.51%) and Sg. Abang O (19.81%).

Zircon can be found in all rivers but not all samples panned, with the highest occurrence from Sg. Abang O (17.15%), followed by Sg. Tebia (14.58%) and Sg. Nibong (12.24%). Monazite also occurs in all the rivers but not all samples, with the highest values in Sg. Abang O (4.76%), followed by Sg. Tebia (1.07%) and Sg. Nibong (1.02%) (Fig. 4).

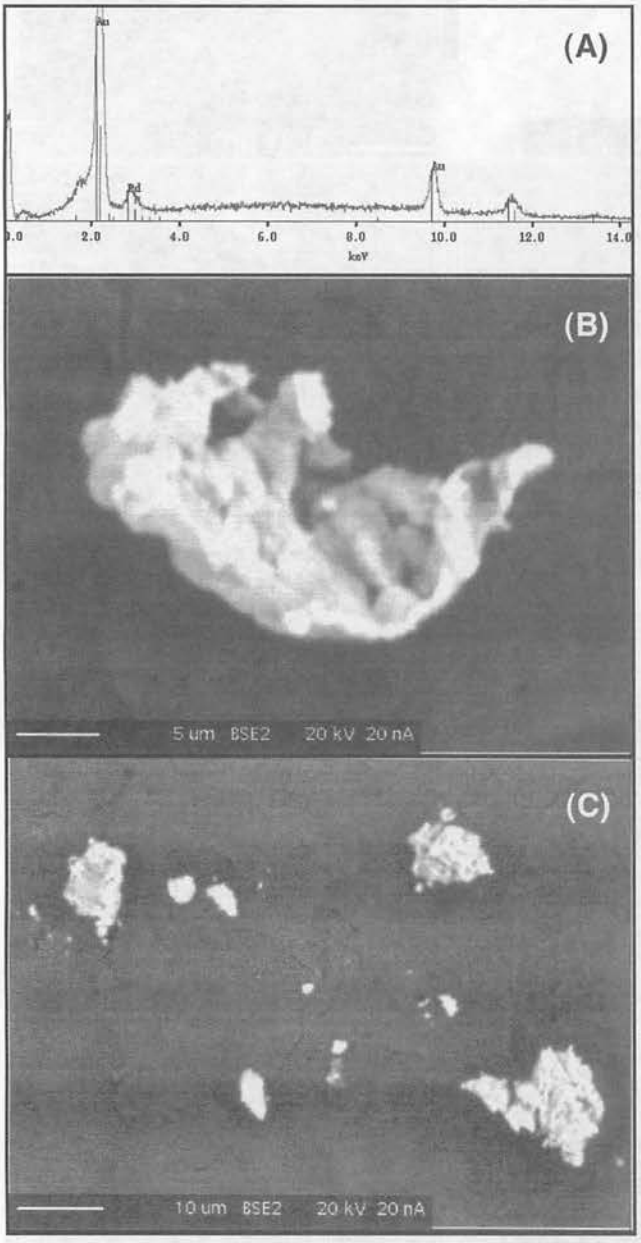

Figure 6. BSE images (B and C) showing the gold grains in Sg. Nibong. EDS scan (A) confirms the presence of Au.

On the other hand, xenotime can be found only in Sg. Abang O (1.9%) and Sg. Semadang (0.47%). Cassiterite was present in Sg. Nibong (2.04%) and Sg. Tebia (0.71%). Cinnabar was found only in Sg. Temurang (0.68%) while hercynite was present in Sg. Temurang (16.44%) and Sg. Abang O (12.26%) (Fig. 5). Finally gold was found in 3 rivers, namely Sg. Nibong (18.3%), followed by Sg. Tebia (1.07%) and Sg. Abang O (0.95%) (Fig. 6).

In terms of size, ilmenite ranges from 100–200 μm. Gold occurs in variable sizes of 25 μm, 10 μm, 5 μm and the smallest are about 1 μm in size with Sg. Tebia having the biggest gold grains. Zircon grains average in size about 100–200 μm with the largest grain 500 μm found in Sg. Nibong, the smallest about 50 μm. Monazite average 100–150 μm in size with xenotime averaging 100 microns. The cinnabar is 50 μm in size with cassiterite averaging 50 μm while the largest grain is 250 μm in size.

CONCLUSIONS

From the distribution of heavy minerals in the various rivers sampled, it is clear that the Annah Rais- Bayur area has good potential for economic mineral resources of Au, Sn, Ti and Hg.

This initial geochemical exploration of stream sediments with the aid of the EPMA has identified the rivers where more detailed exploration should be carried out with the view of tracing the occurrences of gold, cassiterite, ilmenite and cinnabar, in particular, to their source areas.

For gold, further exploration should target Sg. Nibong, Sg. Tebia and Sg. Abang O, for cassiterite, the rivers Sg. Nibong and Sg. Tebia should be targeted, while for ilmenite exploration should target Sg. Semadang and for mercury the search should be in Sg. Temurang.

REFERENCES

FLEISCHER, M., 1983. *Glossary of Mineral Species*. Mineralogical Record Inc., Tucson, U.S.A., 202p.

TEH GUAN HOE, 1996. Electronprobe X-ray microanalysis of geological samples. *In:* Proceedings 6th Scientific Conference, Electron Microscopy Society, malaysia, 26–27 October 1996, Petaling Jaya, 26–27.

WILFORD, G.E. AND KHOO, C.H., 1965. Penrissen area, West Sarawak, Malaysia. *Geol. Surv. Malaysia Borneo Reg. Report*, 2, 195p.