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Sungei Isahan - a new primary tin occurrence in Sumatra

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Abstract : The newly discovered primary tin occurrence at Sungei Isahan, Sumatra, Indonesia, has cassiterite mineralization emplaced on the slope of Bukit Pintu Tuju in fine-grained muscovite granite characterized by strong hydrothermal alteration.

The granite grades into greisen zones which often border quarts veins and lenses that carry tourmaline, muscovite and coarse cassiterite.

A similar radiometric age and geotectonic position allow the Sungei Isahan mineral occurrence to be correlated with the Main Range of Peninsular Malaysia.

INTRODUCTION

A new primary tin occurrence was discovered in 1984 at Sungei Isahan in central Sumatra, Indonesia (Fig. 1), during a technical cooperation project carried out by the Bundesanstalt für Geowissenschaften und Rohstoffe, Federal Republic of Germany, and the Directorate of Mineral Resources, Indonesia. The discovery is the result of the follow-up work to the tin prospecting project in the Tigapuluh Mountains (4000 km^2) in 1975.

GEOLOGY

The cassiterite mineralization at Sungei Isahan is emplaced in a narrow, 100 m long outcrop of fine-grained muscovite granite overlain by metasediments which was incised by the Sungei (brook) Isahan to a depth of 10 m (Fig. 2). Thus only a very small segment of the granite roof was uncovered by erosion and the larger area of interest, accordingly, is a hidden granite cupola.

Strong hydrothermal alteration characterizes the whole granite outcrop. The least altered part of the granite exhibits a fine-grained, anhedral-granular texture with moderately interlocking grains of quartz (40 – 45 vol. -%) and K-feldspar (20 – 25%). Muscovite (30 – 35%) occupies interstices between quartz and feldspar, occurs on micro-fissures, especially in K-feldspar, and forms clusters up to 5 mm across. Some clots of arsenopyrite with a diameter of 5 – 30 mm are occasionally present as well as some subordinate pyrite, chalcopy-

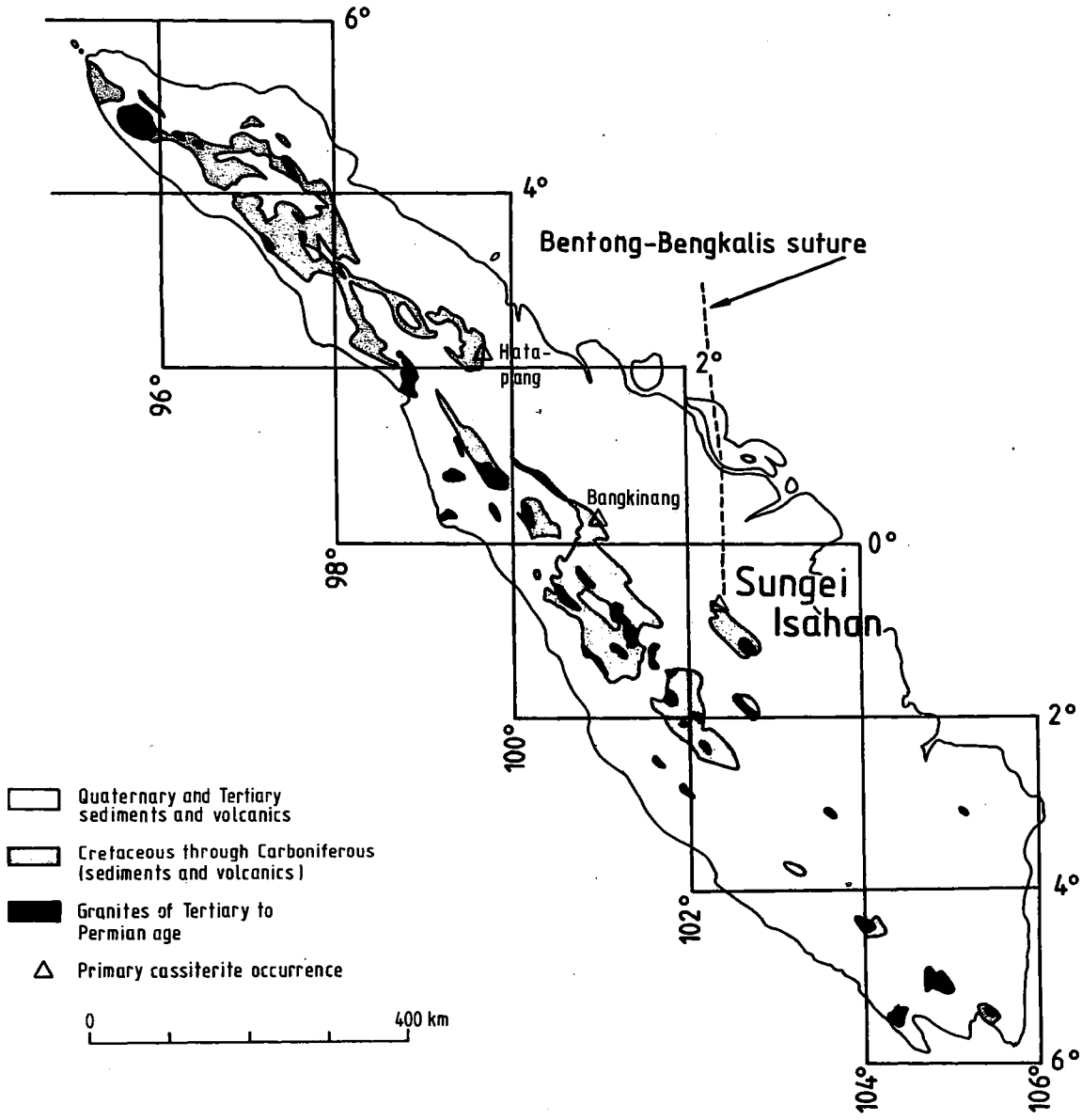

Figure 1: Simplified geological map of Sumatra with primary tin occurrences. After Hamidsyah and Clarke (1982), north of the equator and Hamilton (1979), south of the equator. The Bentong-Bengkalis Suture after Tjia (1989).

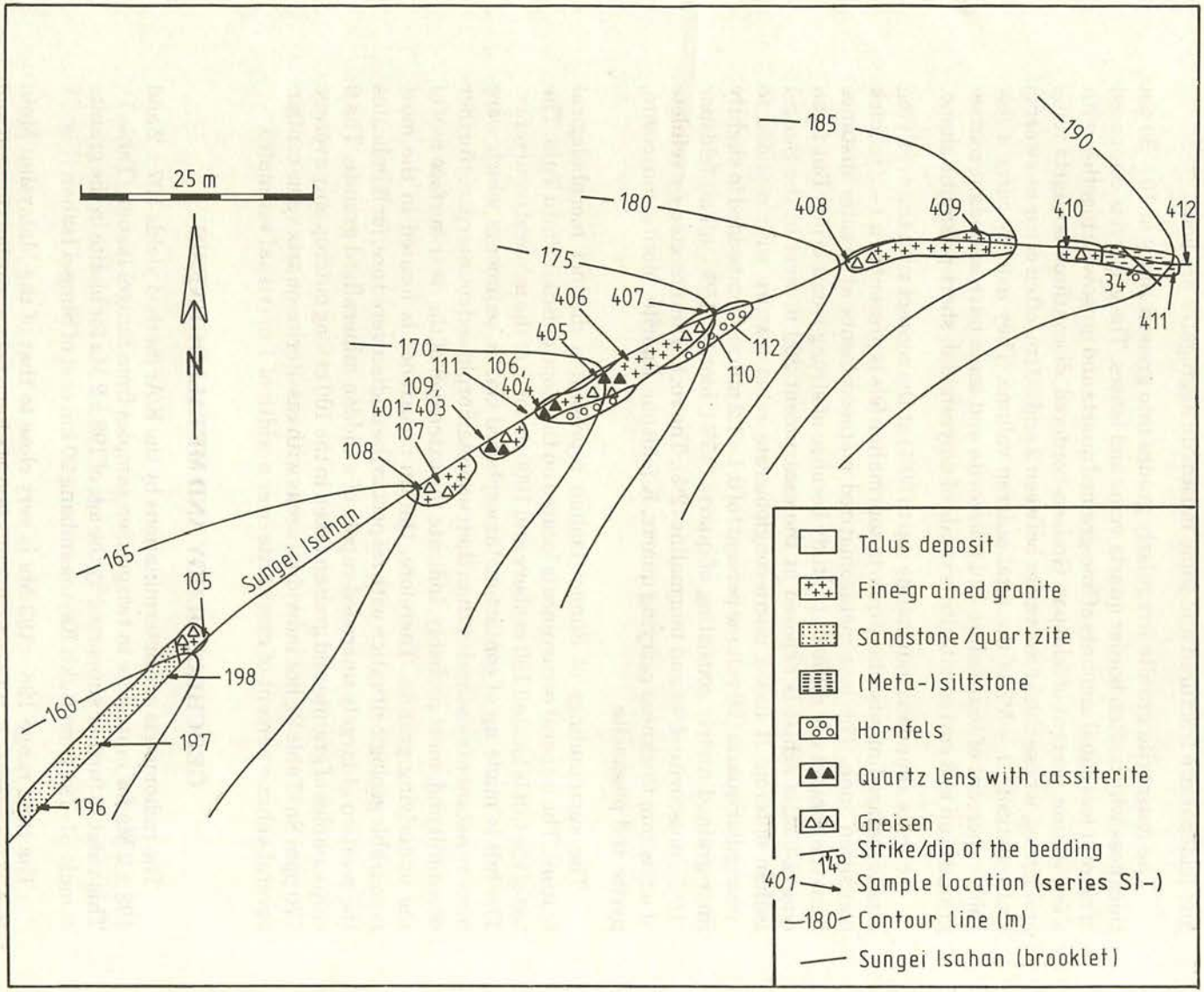

Figure 2: Geological sketch map of the Sungei Isahan primary tin occurrence, Tigapuluh, Sumatra.

rite and galena. The rock has undergone some deformation. Crystals of quartz and feldspar are fractured and some muscovite aggregates are bent.

The muscovite granite irregularly grades into greisen zones of 10 – 30 cm thickness which often border quartz veins and lenses. The greisen is composed of more or less equal amounts of fine-grained quartz and muscovite together with a few volume percent of feldspar. Greisen-bordered, discontinuous quartz veins and lenses, whose thickness varies between 2 and 30 cm, often occur as swarms and constitute 1 – 5% of the total outcrop volume. They usually carry a few volume percent of tourmaline and muscovite and some have abundant coarse-grained (up to 3 cm) cassiterite crystals of dipyramidal, short-prismatic shape.

There is abundant tourmaline (up to 50%) at the contact with the overlying clastic metasediments where quartz-tourmaline fels is present in a 1 – 2 m thick transition zone. The less metasomatized metasediments at greater distance from the contact are difficult to study because of strong weathering. But fresh quartz-biotite schist is exposed at the escarpment 200 m west of the Sungei Isahan outcrop. It has a micro-conglomerate relict texture with rounded to subangular quartz (20 volume percent) of 0.1 – 1.2 mm size embedded in slightly finer-grained matrix consisting of quartz (45%), biotite (15%), alkali feldspar (10%), muscovite (5%) and tourmaline (2%). The rock is intersected by veinlets of a few mm thickness carrying quartz, K-feldspar, fluorite, biotite, muscovite, pyrite and phenacite.

The surroundings of Sungei Isahan represent a distinct morphological feature. The mineral occurrence is located on the slope of Bukit Pintu Tuju. The top of the hill is located 160 m above and 1000 m north of the mineral occurrence. The hill is made up of contact-metamorphosed clastic sediments which were more resistant to weathering than their unmetamorphosed counterparts further down-hill and, most probably, indicate the extension of the near-surface roof of the underlying granite. Therefore, the tin occurrence is located in the most favourable geologic situation with respect to the undiscovered ore, for it indicates the position of largely uneroded cupola of a hidden mineralized granite. The 9 chip samples of granite and greisen taken in the 100 m long outcrop only average 770 ppm Sn (Table 2), but individual areas with cassiterite-quartz veins contain several volume percent of cassiterite over a width of 1 m (visual estimate).

GEOCHRONOLOGY AND METALLOGENESIS

The radiometric age determinations by the K/Ar method yields 197 ± 2 and 193 ± 2 Ma for muscovite in two greisen samples from Sungei Isahan (Table 1). This value is further supported by the age of 198 ± 2 Ma for biotite in the granite sample SI–194 from Bukit Kayumambang 20 km east of Sungei Isahan (Fig. 3).

The time range 198 – 193 Ma is very close to that of the Malaysian Main Range tin granite belt for which 230 – 200 Ma have been recorded (Bignell and

Snelling, 1977; Liew, 1983; Liew and McCulloh, 1985). The Main Range continues into Peninsular Thailand but its southern extension to Indonesia is less clear (Cobbing *et al.*, 1986). The eastern border of the Malaysian Main Range is the Bentong-Raub Suture (Hutchison, 1979). This tectonic line continues southward as the Bengkalis depression (or Bentong-Bengkalis Suture) across the Straits of Malacca until it abuts against the Tigapuluh Mountains near Sungei Isahan (Tjia, 1989; Fig. 1).

The age and the geotectonic position allow the Sungei Isahan mineral occurrence to be correlated with the Main Range. Furthermore, the granites east of Sungei Isahan (sample SI–194 and SI–413; see Fig. 3) are similar to the most abundant granite type in the Main Range. They have 10 – 30% volume percent K-feldspar megacrysts of 15 – 50 mm size enclose in a medium-grained groundmass of quartz (25 – 30%), K-feldspar (15 – 25%) and plagioclase (20 – 30%) of oligoclase composition and 6 – 12% biotite.

It is not possible to correlate Sungei Isahan with the other two primary tin occurrences in Sumatra, Bangkinang and Hatapang, located 200 and 400 km, respectively, further northwest (Fig. 1). The age of the mineralization at Bangkinang is not known; the granite at Hatapang has an age of 78 – 65 Ma (Suryono and Ichihara, 1984) and should better be associated with the Western Granite Belt (Hutchison, 1979) ranging from Phuket in Thailand to east Burma. So far, Sungei Isahan is the only know cassiterite occurrence in Sumatra which can be correlated with the Main Range tin granite belt.

Table 1 : K-Ar analyses on micas in greisen and granites at Isahan and surroundings, Tigapuluh, Sumatra, Indonesia.

Sample Nr	Rock type locality	Mineral	Size fraction (μm)	K/Ar–age* (Ma)	Potassium weight-(%)	Argon (Nnl/g) rad.	atm.
SI-401	Greisen S.Isahan	Muscovite	2000–1000	197±2	8.66(7)	69.9(5)	0.39 (4)
SI–402	Greusen S.Isahan	Muscovite	2000–1100	193±2	9.00(7)	71.4(6)	0.18 (5)
			1100–600	193±2	9.00(7)	71.2(6)	0.3 (1)
SI–194	Granite Kayumambang (20 km E of S. Isahan)	Biotite	125–63	198±2	6.86(5)	55.9(4)	1.2 (1)

* The constant recommended by IUGS (Steiger and Jäger, 1976) has been used. The error (in parentheses) refers to the last digit and represents the 95% confidence limit of the analytical precision. The K/Ar age of the glauconite standard GL-0 is 1% younger than the average in the summary of Odin (1982).

Table 2 : Chemical analyses of granite and greisen at Sungei Ishan and surroundings, Tigapuluh Sumatra, Indonesia.

	Sungei Ishan			Kayumambang (20 km E of S. Isahan)	Batuampar (40 km SE of S. Isahan)
	Fine grained musco-vite granite (SI-108)	Greisen (SI-105)	Average of 9 chips (partly weathered) of granite and greisen**	K.feldspar megacryst biotite granite (SI-194)	K-feldspar megacryst biotite granite (SI-413)
I. MAJOR ELEMENTS					
SiO_2	75.31	66.81	73.86	71.17	71.47
TiO_2	0.01	0.01	0.01	0.48	0.23
Al_2O_3	13.98	19.91	13.80	13.71	14.09
Fe_2O_3*	0.89	2.71	1.74	3.62	2.31
MnO	0.02	0.10	0.04	0.06	0.06
MgO	0.28	0.14	0.12	0.81	0.33
CaO	<0.01	<0.01	<0.01	1.98	1.00
Na_2O	0.31	0.33	0.20	2.78	2.69
K_2O	6.63	6.54	6.04	3.27	6.03
P_2O_5	0.03	0.05	0.03	0.15	0.08
L.O.I.	2.04	2.79	2.59	1.21	1.03
Total	99.57	99.53	98.43	99.25	99.31
II. MINOR ELEMENTS (ppm)					
Ba	91	168	93	204	634
Bi	25	92	58	<6	<6
Ce	35	< 20	< 20	105	81
Co	< 20	< 20	< 20	n.a.	n.a
Cr	5	7	< 2	10	24
Cu	35	7	35	< 5	< 5
La	29	3	15	72	48
Mo	15	49	29	7	4
Nb	35	28	19	22	10
Ni	< 5	< 5	< 5	5	5
Pb	113	36	114	20	26
Rb	718	1085	665	232	302
Sc	5	3	3	7	1
Sn	551	1100	770	7	< 3
Sr	21	5	12	122	138
Ta	9	7	10	7	< 5
Th	23	38	31	55	53
U	12	19	10	19	9
V	15	2	7	42	16
W	63	59	39	6	< 5
Y	241	384	211	48	30
Zn	16	44	24	65	34
Zr	78	76	58	252	145

* Total Fe

** SI-105, 108, 403, 404, 406, 407, 408, 409, 410 (see Fig. 2).

n.a. = not analysed

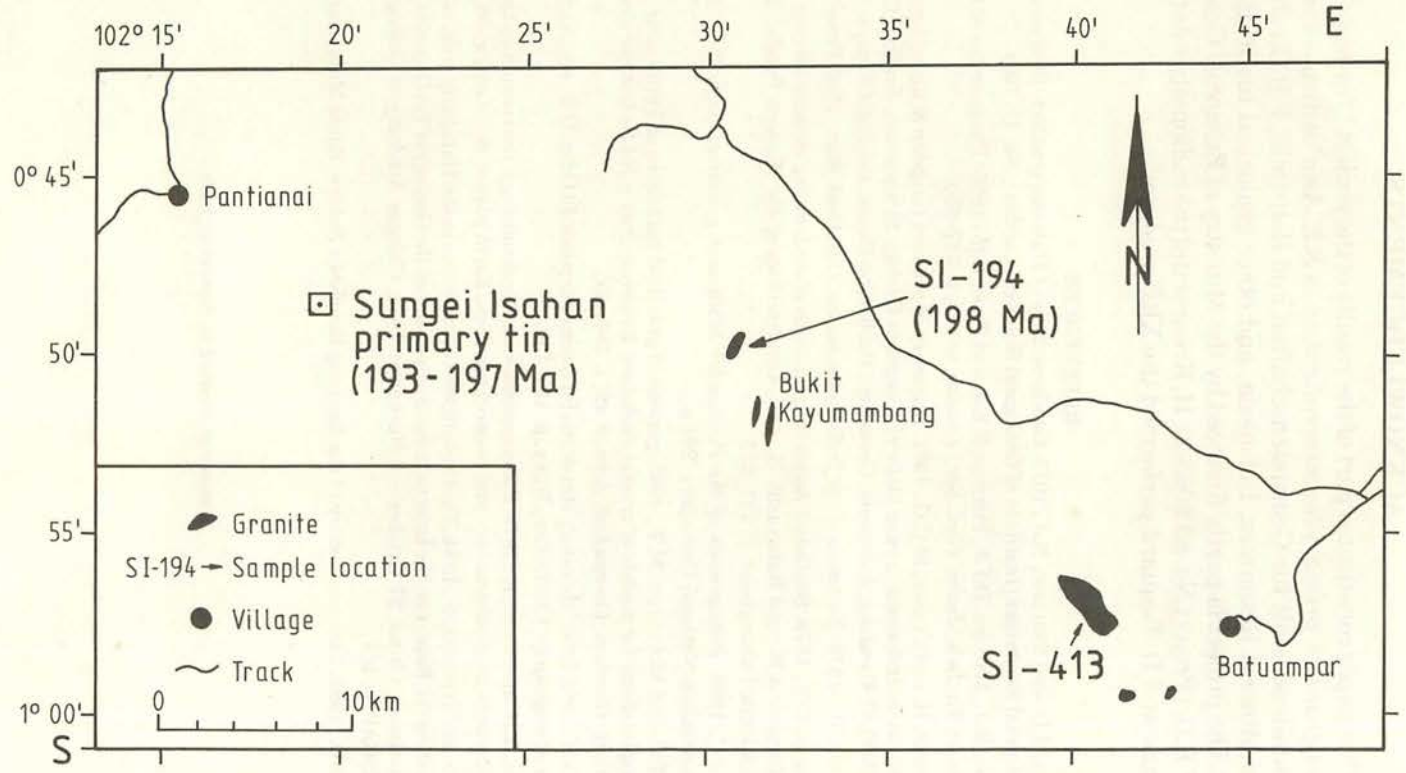

Figure 3: Location of granites in the Tigapuluh area, (from Directorate of Mineral Resources, internal Sungei Isahan primary tin occurrence, Sumatra. K-Ar ages of micas in million years (Ma).

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