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ANATOMY OF CHANTABURI GRANITOIDS: GEOCHRONOLOGY, PETROCHEMISTRY, TECTONICS, AND ASSOCIATED MINERALIZATION

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ABSTRACT

The Chantaburi Granitoids intruded the Upper Paleozoic and Lower Triassic sedimentary rocks. The granitoids include medium-to coarse-grained, porphyritic - to equigranular, mesocratic, hornblende biotite monzogranite to quartz diorite suite and fine - to medium grained, equigranular, biotite ± hornblende monzogranite suite, the latter forming a minor facies and cross-cutting the former. Chemical analyses reveal that both granitoid suites are meta-aluminous, with A/CNK ranging from 0.96 to 1.00 and negligible normative corundum. The petrological and geochemical parameters together with the isotopic constraints strongly indicate that the Chantaburi granitoid suites are of I-type and magnetite - series affinity.

The new $^{40}Ar/^{39}Ar$, the published (recalculated) K-Ar, and the recast Rb-Sr whole-rock isochron geochronological results reveal that the predominantly, I-type Chantaburi granitoids were undoubtedly emplaced at ca. 195 - 209 Ma. The Paleogene thermal event, detected by the minimum apparent dates of $^{40}Ar/^{39}Ar$ age spectrum and the remarkable "young" dates of K-Ar and Rb-Sr mineral data, may have been regional extent, implying a large scale movement on the major Mae Ping, NNE-SSW, sinistral fault zone. The Eocene faulting may have also involved in the 52-59 Ma intrusions of the subordinate, S-type, muscovite - tourmaline pegmatites and biotite granites nearby. Primary (and secondary) non-commercial Sn-W mineralization may be related spatially and temporally to these S-type, Eocene, intrusions rather than to the I-type, Late Triassic-Jurassic, Chantaburi granitoids which may be involved in some uneconomic base metal deposits.

INTRODUCTION

The study area is located in Amphoe Muang, Changwat Chantaburi, about 300 km southeast of Bangkok (Figure 1), and between latitudes 12° 28' and 12° 44' N and longitudes 102° 05' and 102° 18' E (Figure 2). The area forms a part of the Loei Fold Belt contiguous with the western edge of the Indochina craton (Bunopas and Vella, 1983). Its granitoid rocks, called herein "Chantaburi Granitoids" belong to the Eastern Granite Belt (Pongsapitch et al., 1983 and Charusiri et al., 1990).

Neither primary high-grade tin nor tungsten deposits have been reported in the study area, but Aranyakanon (1968) and Tantisukrit (1978) note that very large crystals of cassiterite have been discovered in the tributaries of the Nam Tok Plieu, Changwat Chantaburi. To the north and northeast of the immediate area, tin mineralization occurs in stream and colluvium at Khao Soi Dao Tai, Khao Sabab, Khao Klat and Khao Chak Lao, immediately N of Changwat Chantaburi (Hughes and Bateson, 1967; Kuentuk, 1971; Kokcharoensup, 1971). Tungsten minerals were also reported at the same localities and at Khao Chamao, west of Chantaburi.

The aim of this paper is to define types and ages of Chantaburi Granitoids and to discuss the relevant tectonics and associated mineralization.

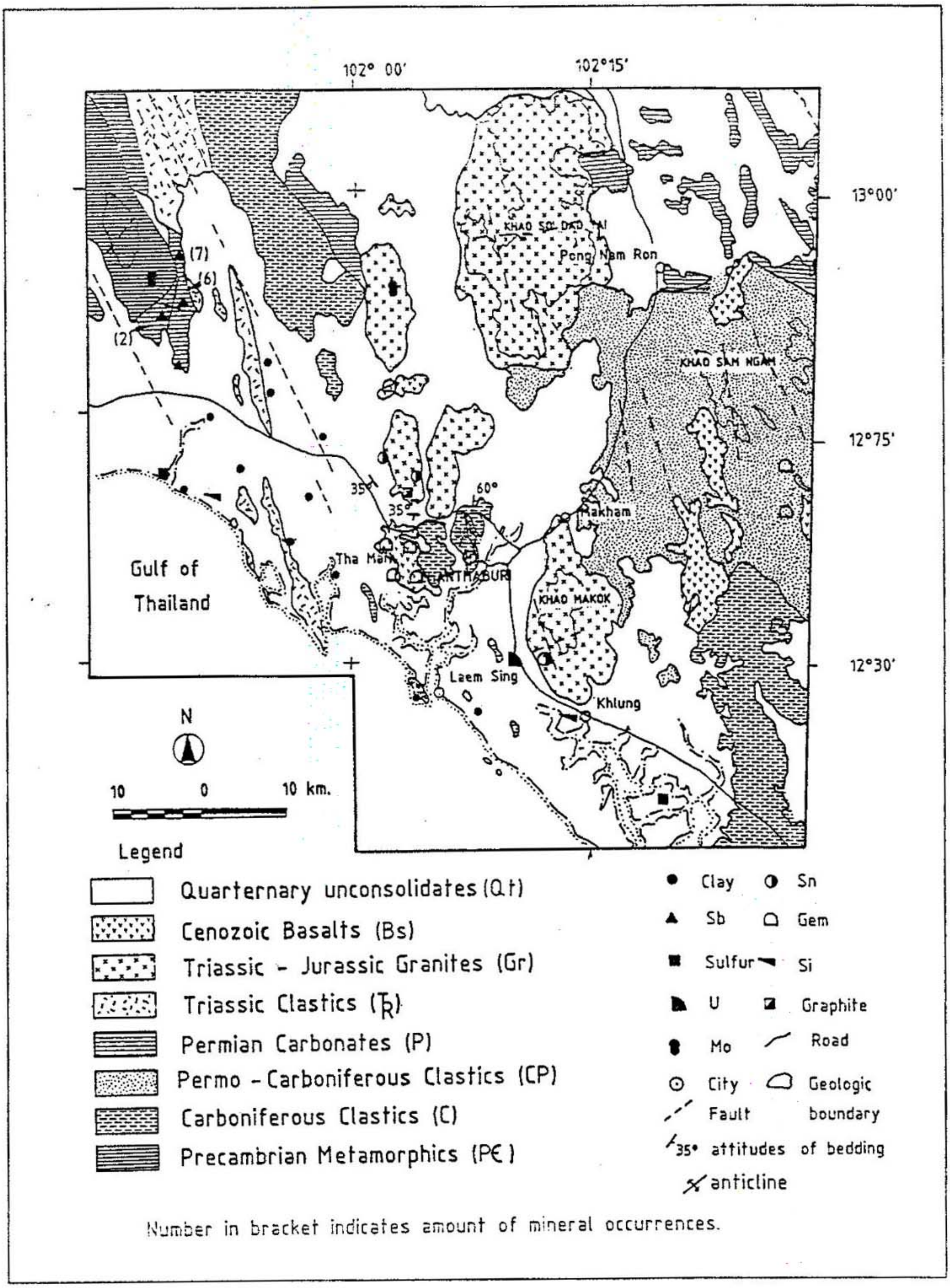


Figure 1. Simplified geological map (modified after Chongakmani et al., 1983) and mineral occurrences (Kokcharoensap, 1972; MRDP; 1986) of the Chantaburi and nearby areas. Note Clay = mostly Kaolinite; Sb = Antimony; S = Sulphur; U = Uranium; Sn = Cassiterite; Mo = Molybdenite; Gem = Gemstone; Si = Silica sand.

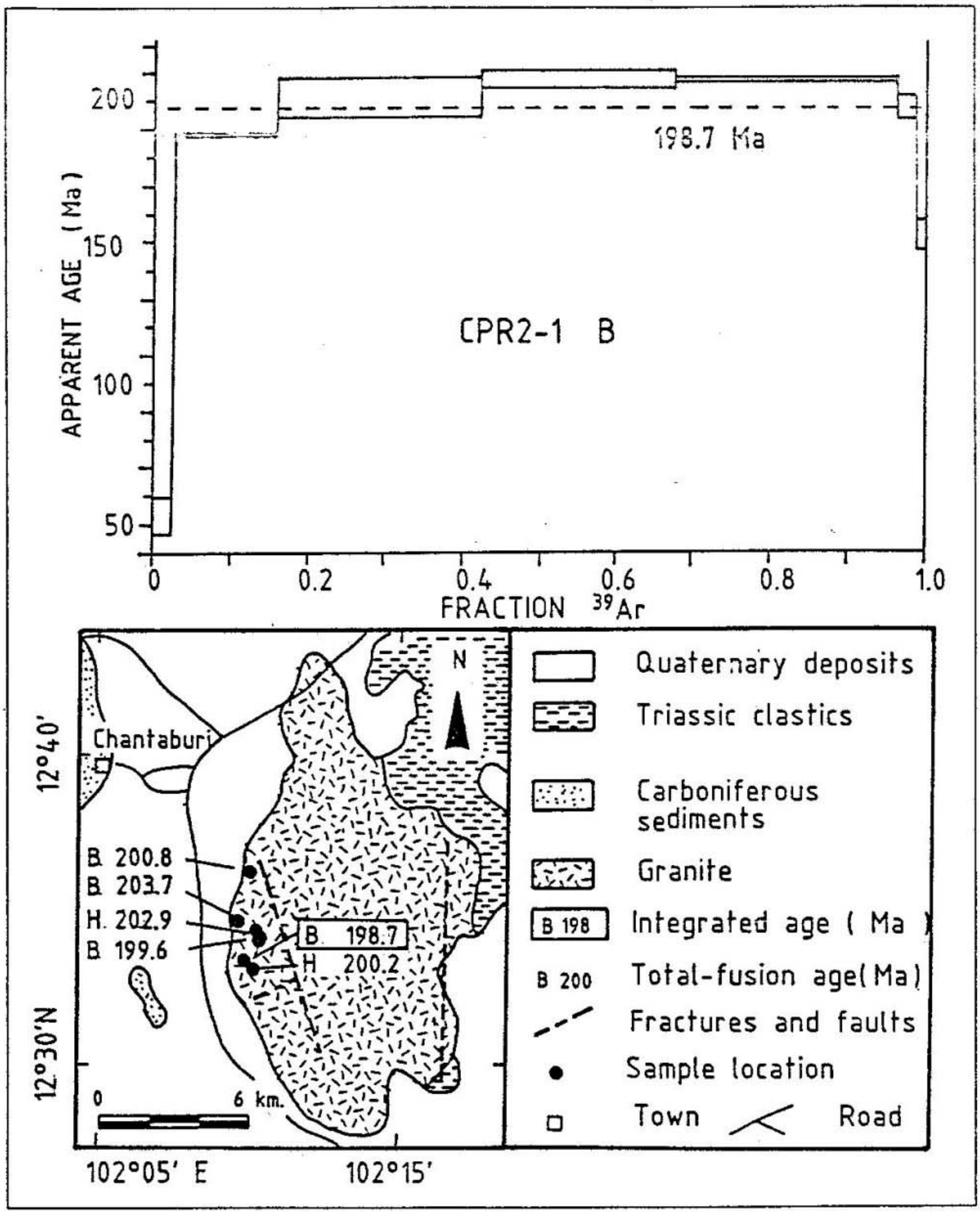


Figure 2. Geological sketch - map of the Chantaburi Granite, from Charusiri (1989), showing the locations of the $^{40}Ar/^{39}Ar$ - dated sample and the single step - heating age spectrum carried out in this district.

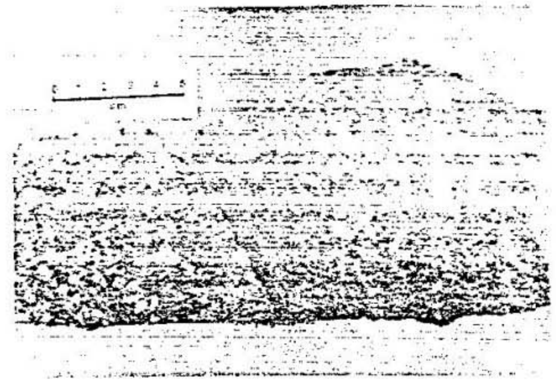
GEOLOGY AND PETROCHEMICAL ASPECTS

General Geology

The geology of the Chantaburi area (Figure 1) is described in detail by Tansathien et al. (1976), and reviewed by Chonglakmani et al. (1983) and the Royal Thai Department of Mineral Resources (1987). The study area is underlain by granitoid rocks and by Upper Paleozoic and Triassic strata (Figures 1 and 2). The older sedimentary rocks, exposed only in the western part of the area, include well - bedded radiolarian chert and minor limestone lenses; the strata are herein assigned to the Carboniferous Dan Lan Hoi Group. The eastern part of the area is characterized by Lower Triassic non-marine clastic rocks of the Khorat Group, comprising graywackes interbedded with thinly-bedded limestone and shale. Thansathein et al. (op. cit.) referred this rock sequence, termed the Pong Nam Ron Formation, to the Triassic, whereas Chonglakmani et al.(1983) remapped it as the Kaeng Krachan Formation of Carboniferous age. The Royal Thai Department of Mineral Resources (1987), however, favoured a Triassic age.

Petrochemistry of Chantaburi Granitoids

The Triassic clastic sediments (Figure 2) were intruded by granitoid rocks assumed to be of Triassic age (Hughes and Bateson, 1967). Good exposures of the granitoids are located along two famous water falls, the Nam Tok Plieu and the Nam Tok Klong Narai. The intrusive rocks can be divided into coarse- and fine-grained varieties, the former predominating. The coarser-grained rocks include large volumes of medium -to coarse-grained, porphyritic -to equigranular, mesocratic, biotite-hornblende granite. Petrographic investigation reveals that the rocks consist largely of anhedral (to subhedral) quartz (av. 20 % modal volumes), subhedral orthoclase (23 %, large subhedral, zoned oligoclase to andesine (27 %), green-pleochroitic, long-prismatic hornblende (11 %, and green, coarse, flaky biotite (15 %). The megacrysts (av. 1.5 cm x 3 cm) are mainly of subhedral to anhedral orthoclase perthite, some irregularly mantled by oligoclase, constituting a clearly-defined rapakivi texture (Figure 3). Significant accessories (4 %) are sphene, magnetite, allanite, zircon and apatite, the former being the most abundant. Modal analyses (Charusiri, 1989) reveal that the suite ranges in composition from monzogranite to quartz diorite (sample nos. 15, 16 and 17 in Figure 3). Green to greenish brown biotite (7.2-8.7 modal %), with abundant sphene and apatite inclusions, and green hornblende (10.8 - 16.3 %) are ubiquitous. The finer facies, which intrudes the coarser-grained granitoids, is a fine - to medium - grained, equigranular, biotite (±hornblende) granite. Charusiri (op. cit.) states that these rocks are monzogranitic (sample nos. 18 & 19 in Figure 4) in composition. petrographically, the rocks comprise anhedral quartz (av. 28 % modal volume), subhedral, untwinned microcline (large negative 2V; 24 %), subhedral to euhedral, zoned oligoclase (26 %), brown biotite (16 %) and greenish brown hornblende (6 %). The major accessories are sphene, magnetite, zircon and apatite, the latter predominating. Modal composition (Figure 4) indicates that there exists a differentiation trend from more mafic sample of hornblende - rich granitoid (CKR-1) to less mafic biotite variety (CPR-4)



a

b.

Figure 3 Granitoid Rocks of the Chantaburi Area.

a. Stained slabs of coarse - grained porphysitic, hornblende - biotite monzogranites (sample nos. CPR - 1 - 2 and CKR - 2) from Nam Tok Plieu, Changwat Chantaburi, Sample CKR - 2 shows repakivi texture, in which potassium feldspar is mantled by oligoclase. N.B. Plagioclase=pink; potasssium feldspar=yellow, biotite=deep greenish black, quartz and hornblende=unstained.

b. Photomicrograph showing hornblende (H) and biotite (B) in monzogranite, a dated CPR - 5 sample, from the Chantaburi area. (Bar scale=1mm, transmitted light, crossed nicols)

Chemical analyses (sample nos. CKR - 1, CPR - 1, CPR - 2, CPR 3 and CPR - 5 in Table 1; and see also Table 1 in Lehman and Mahawat, 1989) indicate that both granitoid types are metaluminous, with A CNK ranging from 0.96 to 1.00 and negligible normative corundum (nil to 0.24 wt %). The widespread occurrence of hornblende, primary sphene, magnetite and allanite, the absence of magmatic muscovite, the nearly equivalent abundance of sodium and potassium (e.g. 3.72 wt. % Na_2O at 3.79 % K_2O: see Table 1) the low A/CNK ratio, normative corundum, and the low initial Sr isotopic ratios (see below), clearly indicate that the granitoid rocks of the Chantaburi are are of I - type (Chappel & White, 1974) and magmatite - series (Ishihara, 1977) affinity.

Table 1. Whole-Rock Analyses and CIPW Norms of Chantaburi Granitoids, SE Thailand.

Sample Oxide	CKR-1	CPR-5	CPR-2	CPR-3	CHAN[1]	198[2]	190[2]	191[2]	192[2]	193[2]	194[2]	195[2]	196[2]
SiO_2	73.19	73.41	67.53	69.41	70.28	72.77	68.05	71.45	72.03	67.28	68.48	70.17	66.60
TiO_2	0.37	0.10	0.53	0.50	0.41	0.28	0.61	0.40	0.37	0.40	0.55	0.48	0.65
Al_2O_3	13.61	13.77	14.69	14.23	14.34	14.19	15.14	13.84	13.72	14.60	14.23	13.87	14.73
Fe_2O_3	0.96	0.25	0.95	0.94	-	0.35	0.26	0.49	0.11	0.67	0.81	0.35	0.78
FeO	2.68	0.69	3.05	2.18	3.38	1.68	3.52	2.92	2.68	4.40	4.12	3.92	4.75
MnO	0.05	0.04	0.06	0.09	0.06	0.04	0.04	0.03	0.02	0.04	0.07	0.06	0.10
MgO	0.52	0.10	0.82	0.75	0.46	0.39	0.84	0.51	0.51	0.53	0.87	0.81	0.88
CaO	1.74	1.72	2.62	2.48	2.06	1.25	2.98	2.17	1.94	2.30	2.74	2.34	3.21
Na_2O	3.63	3.67	4.06	3.72	3.76	3.50	3.23	3.37	3.02	4.48	3.94	3.75	3.76
K_2O	4.11	4.85	3.42	3.79	3.96	4.89	4.65	4.24	5.16	3.18	3.51	3.80	3.58
P_2O_5	0.09	0.01	0.16	0.16	0.09	0.14	0.17	0.09	0.10	0.11	0.14	0.11	0.16
LoI	1.00	0.56	1.60	1.10	0.68	0.56	0.66	0.56	0.59	1.78	0.59	0.51	0.50
Tot	101.94	99.17	99.49	99.34	99.48	100.40	100.15	100.70	100.25	99.77	100.49	100.17	99.69
A/CNK	**1.00**	**0.98**	**0.96**	**0.96**	**0.96**	**N.D.**	**N.D.**	**N.D.**	**N.D.**	**N.D.**	**N.D.**	**N.D.**	**N.D.**
CIPW NORMS													
Q	28.65	29.99	22.70	26.16	28.55	29.69	21.97	28.47	28.18	20.52	22.94	25.28	20.44
Or	24.29	28.90	20.21	22.40	23.48	28.90	27.48	25.05	30.49	18.79	20.79	22.45	21.15
ab	30.72	31.05	34.19	31.48	31.93	29.61	27.33	28.51	25.55	37.91	33.34	31.73	31.81
an	8.04	6.66	11.85	10.98	9.67	5.37	13.08	10.11	8.69	10.34	10.78	9.79	12.74
C	0.24	-	-	-	0.68	-	-	-	-	-	-	-	-
hy	4.91	0.41	5.99	9.25	0.76	3.38	7.08	5.56	5.33	8.03	7.40	7.71	8.36
mb	1.39	0.36	1.38	1.36	0.34	0.51	0.38	0.71	0.16	0.97	1.17	0.51	1.15
il	0.70	0.19	1.01	0.95	0.13	0.53	1.26	0.76	0.70	0.76	1.04	0.91	1.23
ap	0.21	0.02	0.32	0.32	0.20	1.17	-	-	-	-	-	-	-
di	-	1.56	0.26	0.38	-	-	0.64	0.12	0.37	0.42	1.72	1.02	1.96
Hm	-	-	-	-	3.00	-	-	-	-	-	-	-	-

**** Note ** N.D. = not determined; - = 0.00; 1 = Lehman and Mahawat (1989); 2 = Pitfield (1988)**

GEOCHRONOLOGY

Previous Geochronological Studies.

As in the Rayong-Klang and Satthahip-Ban Chang areas (see Charusiri, 1989), the published geochronological information is provided by Burton and Bignell (1969) and Bignell (1972) Burton and Bignell (op. cit.) dated coarse-grained, porphyritic, biotite - hornblende granite from the Nam Tok Plieu (locality B6 in Figure 5). The rock gave a K-Ar hornblende age of 204.5 Ma, a K-Ar biotite age of 194 Ma, both dates were recalculated by the authors using new constant proposed by Steiger & Jager (1977). The granite also yielded a Rb-Sr whole - rock model age of 144 ± 65 Ma, using an assumed initial Sr isotopic ratio (ri) of 0.709. Bignell (op. cit.) recalculated the Rb-Sr age as 170 ± 14 Ma, applying an ri of 0.708. He also dated two other hornblende - biotite granite samples collected along the Chantaburi - Krathing Road, 120 km NW of Chantaburi (B7 in Figure 5). The rocks gave different K-Ar biotite ages of 52.3 and 138 Ma. Another hornblende - biotite granite, form the eastern flank of Khao Kamut, 35 km N of Chantaburi (B9), yielded a K-Ar biotite age of 119 Ma and a Rb-Sr whole - rock model age of 208 Ma, assuming an initial ratio of 0.708. A sample of biotite granite from Khao Chamao (B10), 55 km NW of Chantaburi, yielded a Rb-Sr whole - rock model age of 58 Ma, applying the same initial ratio.

New $^{40}Ar/^{39}Ar$ Age Data

Details of $^{40}Ar/^{39}Ar$ geochronological method can be found in Charusiri (1989) and will not be mentioned herein. Dating analysis was performed at a GEOCHRON Laboratory, Queen's University,

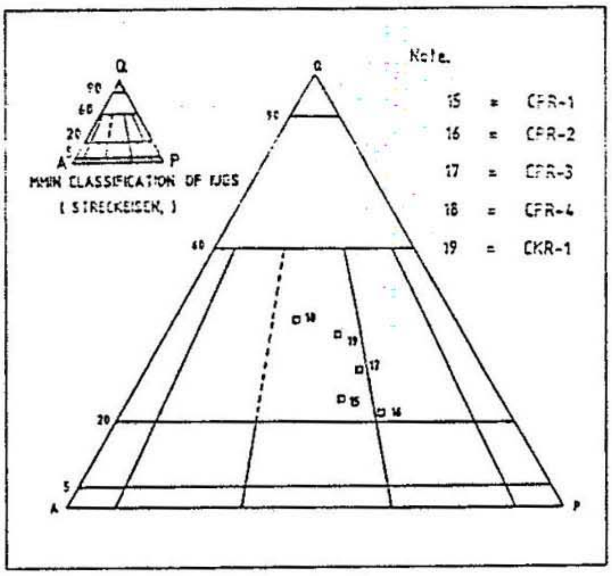


Figure 4. Simplified modal composition (quartz, alkali feldspar and plagioclase) of granitoids from Chantaburi and nearby area, plotted on QAP diagram recommended by the IUGS subcommission on the Systematic of Igneous Rocks (Streckeisen, 1973)

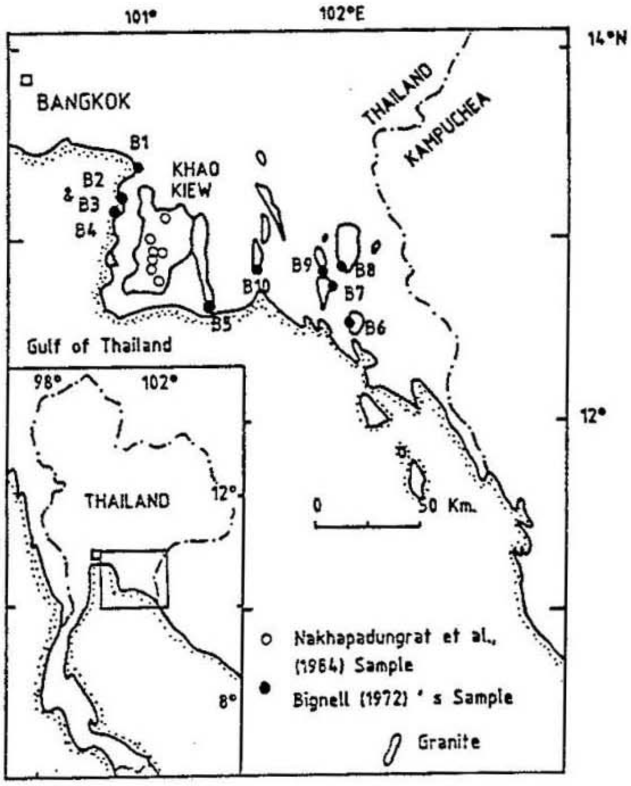


Figure 5. Distribution of granitoid intrusions (outlined area) and locations of the previously-dated granitoid rocks in the vicinity of the northeastern littoral of the Gulf of Thailand (Bignell, 1972, Nakapadungrat et al., 1984). N.B. Rb/Sr data for samples from localities B6, B8 and B10 are plotted in Figure 6.

Kingston, Ontario, Canada. Five samples of granitoid rocks (CPR -1, -2, -4 and -5, and CKR -1) were selected for $^{40}Ar/^{39}Ar$ dating using both total -fusion and step-heating techniques. The geochronological data are presented in Table 2 and 3. Samples of coarse - grained, porphyritic, hornblende biotite monzogranite (CPR-4) and quartz diorite (CPR-2) were collected on the banks of Nam Tok Plieu, 8 km SE of Chantaburi (Figure 2). Hornblende concentrates from the two rocks gave similar total-fusion ages of 202.9 and 200.2 Ma, respectively. Biotite from a coarse-grained, porphyritic, biotite - hornblende monzogranite (CPR-1), and from a fine-grained, biotite granite (CPR-5) which intrudes CPR-1, yielded total fusion ages of 203.7 and 199.6 Ma, respectively. A medium-grained, porphyritic, biotite (± hornblende) granite (CKR-1) from the Nam Tok Klong Narai, 2 km north of the Nam Tok Plieu, gave a similar total-fusion biotite age, of 200.8 Ma.

A biotite concentrate from a coarse - grained, porphyritic, biotite-hornblende quartz diorite (CPR 2-1), collected on the Nam Tok Plieu, was selected for $^{40}Ar/^{39}Ar$ step-heating. The biotite displays a slightly disturbed age spectrum wtih an integrated age of 198.7 Ma (see Figure 2). About 80% of the ^{39}Ar released defines a plateau with an average age of ca. 207 - 208 Ma. This is in excellent agreement with Bignell's K-Ar hornblende age (204 MA) from the same location. There is a consistent increase in the apparent ages for the first few steps, and the minimum in the release spectrum, at ca. 54 Ma, may represent the time at which radiogenic argon loss ocurred through volume diffusion (Turner, 1968). A thermal event of this age is tentatively inferred. The drop in apparent ages from 201 to 150 Ma at the highest temperature step (Table 1 and Figure 2) can perhaps be explained by recoil of ^{39}Ar in more retentive lattice positions would be transferred to less retentive sites, resulting in a lower apparent age.

DISCUSSION

Ages of Granitoids : K-Ar, Ar-Ar, and Rb-Sr Whole-Rock Analyses

The new $^{40}Ar/^{39}Ar$ and the published K-Ar dating results reveal that the medium-grained, porphyritic hornblende - biotite, monzogranite and quartz diorite in this and adjoining areas, were undoubtedly emplaced at ca. 195 to 207 Ma. The Rb-Sr whole - rock apparent ages of similar granitoid rocks are clearly inconsistent, varying from 144 to 208 Ma. Due to the low content of Rb and low $^{87}Sr/^{86}Sr$ rati

Table 2. $^{40}Ar/^{39}Ar$ data for total-fusion analyses of granitoid and mineralized rock of Central Thailand. (Charusiri, 1989)

Sample No.	Location Lat. E Long. W	Mineral (Rock)	$^{40}Ar/^{39}Ar$ (Ma)	$^{36}Ar/^{39}Ar$	$^{37}Arca/^{39}Ark$	J-VALUE	$^{40}Ar^*$	Age ± 2 Error
CPR-1	12° 34' 102° 10'	B (G)	24.71	4.312E-3	5.901E-2	4.837E-3	95.1	203.7 ± 0.5
CPR-2	12° 33' 102° 10'	H (G)	24.35	8.450E-3	5.056	4.821E-3	91.9	200.2 ± 3.9
CPR-4	12° 34' 102° 10'	H (G)	24.86	9.736E-3	4.902	4.790E-3	90.8	202.9 ± 1.0
CPR-5	12° 34' 102° 10'	B (G)	24.50	4.421E-3	1.170E-1	4.775E-3	94.9	199.6 ± 0.6
CKR-1	12° 36' 102° 10'	B (G)	24.73	3.647E-3	1.734E-1	4.760E-3	95.8	200.8 ± 2.2

B= biotite, H=hornblende, G=granite

Table 3. Gas-release data for CPR-2 biotite, Changwat Chantaburi

Temp (°C)	$^{40}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$	$^{37}Arca/^{39}Ark$	Ca/K	Vol. ^{39}Ark ($10^{-6}cm^3NTP$)	% ^{39}Ark	% $^{40}Ar^*$	Apparent Age (Ma)	Error ± 2 (Ma)
500	6.229	1.408E-1	1.375	0.252	4.702E-3	2.259	13.02	53.20	6.34
600	22.88	1.479E-2	0.012	0.023	2.838E-2	13.63	83.91	188.2	0.5
700	24.54	1.494E-3	0.011	0.019	5.461E-2	26.23	98.17	201.1	6.5
800	26.04	1.507E-3	0.015	0.027	5.262E-2	25.27	98.26	208.1	2.9
900	25.29	1.033E-3	0.030	0.054	5.987E-2	28.76	98.75	206.9	0.7
1050	24.10	8.720E-3	0.856	0.057	5.299E-3	2.546	90.49	197.6	4.4
1200	18.33	3.423E-2	0.225	0.041	2.698E-3	1.296	64.43	152.3	5.4

Integrated age = 198.7 ± 3.0 Ma
J-Value = 4.805 x 10^{-3}
location = Lat. 12° 30' N; Long. 102° 10' E

Table 4. Whole-rock Rb-Sr analyses of the Chantaburi granitoids.

Sample	Rb (ppm)	Sr (ppm)	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$	Rb-Sr Age (modal)
B6	201	150	4.27	0.7182	170Ma
B8	352	134	5.43	0.7246	208Ma
B10	232	248	2.71	0.7163	58Ma

Data from Bignell (1972)

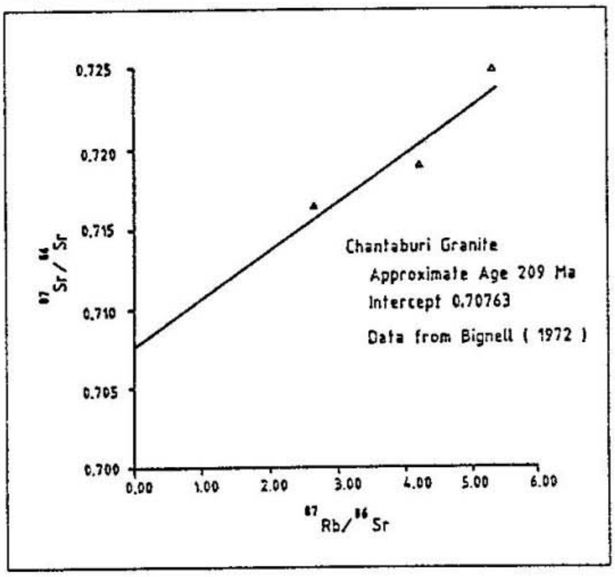


Figure 6. Recast Rb - Sr isochron plot for the Chantaburi granites. Data from Bignell (1972).

(see Table 33 and Figure 28 of Bignell, 1972), the Rb-Sr data cannot be fitted to an acceptable isochron. The Rb-Sr data for the Chantaburi Granitoids (Bignell, op. cit.) are recasted (Table 4) and recalculated herein to generate a new Rb-Sr whole - rock isochron (Figure 6). The date obtained from this plot is approximately 209 Ma, with an r_i of 0.70763. Because only three analyses are available and the data do no conform to a straight line, the authors conclude that the date does not accurately represent the true age of granitoid intrusion. However, it is only slightly higher than those of the K-Ar and $^{40}Ar/^{39}Ar$ ages. The fine- grained biotite granite which intrudes the hornblende - biotite granite and quartz diorite is considered also to be of Late Triassic - Early Jurassic age. It is noteworthy that there is no marked contrast between the $^{40}Ar/^{39}Ar$ dates and Rb-Sr whole-rock isochron dates, implying that I-type granitoids always gave similar dating results using both methods. The mineral pair (biotite and hornblende) also gave nearly the same dates, indicating that the granitoid cools rapidly. And the dates obtained are considered to be "true" age of granitoid. This granitoid- suite emplacement is slightly younger than that of the S-type granitoid suite in Chonburi area (Nakapadungrat,1981, Charusiri, 1989)

Tectonic and Tectono - magmatic Aspects

The youngest K-Ar biotite data (ca. 52.3 Ma) recorded by Bignell (1972) for a similar hornblende-biotite granite from the Chantaburi-Krathing Road corresponds fairly well to the age minimum of the step - heated sample herein (ca. 54 Ma), and may represent the same Paleogene thermal event. The local crustal temperature at this time is inferred to have been high enough to reset totally the biotite age, whereas two other biotite ages (118 and 113 Ma) from more northerly locations were only partially reset. The thermal event also corresponds to the Rb-Sr whole-rock apparent age (about 58 Ma) of biotite granite from khao Chamao, 55 km W of Chantaburi. It is reasonable to propose that the thermal event may have been of regional extent rather than being related to, e.g., local intrusion. A possible explanation would be movement on the major Mae Ping NNW - SSE sinistral fault zone extending from NW Thailand through the Central Chao Phraya basin (Charusiri, 1989). The faulting may also have been involved in the generation of the 59 Ma muscovite age obtained from the muscovite- tourmaline pegmatite, farther to the WNW in Changwat Chonburi (see Charusiri, 1989).

Two major tectono-magmatic episodes are, therefore, postulated for the Chantaburi area. The first is the emplacement of I-type granitoid rocks at ca. 195 to 207 Ma (Early Jurassic), and the second is tentatively inferred to have involved movement on the Mae Ping fault-zone in the Eocene, at ca. 52 to 58 Ma. The 52-58 Ma intrusion of biotite muscovite granite and pegmatite may have been related genetically and temporally to the faulting.

The generation of main-phase, rapidly cooled I-type, hornblende-biotite, metaluminous is interpreted herein to have occurred as a result of partial melting of the east-dipping basaltic oceanic lithospheric plate beneath the Indochina cratonic terrane. Such basaltic melt was activated shortly after, or immediately at the end stage of, the Shan Thai and Indochina continental collision very close to the Nan-Chantaburi suture zone (Hada, 1992) during Triassic - Jurassic period. Late - stage emplacement of alteration-related granitoid suite may have given rise to some uneconomic mineral deposits. The second episode, which occurred during Tertiary, involved the movement along the Mae Ping Fault and generation of minor - phase, S - type granitoid and its associated mineral deposits (see details below).

Associated Mineralization

The provenance of the coarse, alluvial, cassiterite occurring near the Nam Tok Plieu remains problematic. In the authors' view, the locally - predominant I-type granitoid rocks represent an unlikely source, and the cassiterite and possible uranium (see Figure 1) were more probably from the erosion of S-type pegmatites or granitoids emplaced in the Early Eocene. This is supported by the occurrence of cassiterite in other local areas displaying disturbed ages for granitic rocks, e.g., north of Changwat Chantaburi. The tungsten showing at Khao Chamao, W of Changwat Chantaburi, may have also been related spatially and temporally to ca. 58 Ma biotite granites.

In addition, the works of Kokcharoensap (1972) and Lehman & Mahawat (1989) clearly support that the Chantaburi main-phase granitoid suite are devoid of tin. It is, however, important to point out here that geochemical analyses from soil and stream-sediment samples in the Khao Klad and Khao Soi Dao Tai areas, north of Changwat Chantaburi (Kokcaroensap, op. cit; Kuentak, 1971) reveal that the area concerned generally has low contents of Sn and W, except in areas where the cassiterite and wolframite occurrences were reported. However, quite high content of Sb, Mo, Pb, Zn and Cu were also encountered in such geochemical samples, implying that the granitoid suites of the Chantaburi area are enriched in such elements. This is confirmed by mineral occurrences shown in Figure 1 and the overall figure of granitoid and the mineral occurrences may have been related more or less to the I-type granitoid emplacement in Changwat Loei, NE Thailand with which the ages and trace-element composition are comparable (see Charusiri, 1989).

CONCLUSIONS

Two major granitoid suites are recognized in the Chantaburi area, namely the coarse-grained and the fine-grained, biotite-hornblende granitoids. Petrological and geochemical evidences indicate that the granitoids are of I-type affinity. The $^{40}Ar/^{39}Ar$ dating as well as the previous K-Ar and Rb-Sr geochronology confirm that the granitoid suites were emplaced during Late Triassic (or 195 - 209 Ma). The geochronological investigation also advocates that the Paleogene tectono - thermal event involving the sinistral movement of the large-scale NNW-trending, Mae Ping fault zone, may have been responsible for the generation of the minor, S-type, Sn-W-bearing, mica (±tourmaline) granites and pegmatites. The predominant, Chantaburi I-type granitoids are considered to be tin (±tungsten) - barren.

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