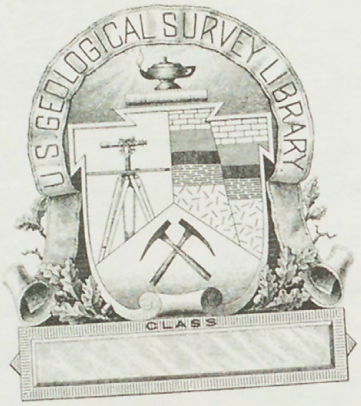
U.S. GEOLOGICAL SURVEY LIBRARY
CLASS

(200)
R290
no.74-216

U.S. Geological Survey. [Report]
Open file series]

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

USGS LIBRARY-RESTON
3 1818 00076971 9

PROJECT REPORT
Indonesian Investigations
(IND-34)

PRELIMINARY REPORT ON THE GEOLOGY OF THE SOLOK QUADRANGLE, WEST SUMATRA

U. S. Geological Survey
OPEN FILE REPORT
This report is preliminary and has not been edited or reviewed for conformity with Geological Survey standards or nomenclature.

251775

Prepared under the auspices of the
Government of Indonesia and the
Agency for International Development
U. S. Department of State

1974

(200)
R290
0.74-216

U. S. GEOLOGICAL SURVEY
RESTON, VA.
SEP 3 1974
LIBRARY

PRELIMINARY REPORT ON THE GEOLOGY OF THE SOLOK QUADRANGLE, WEST SUMATRA

By

Keith Robinson

U. S. Geological Survey

CONTENTS

ILLUSTRATIONS

PRELIMINARY REPORT ON THE GEOLOGY OF THE SOLOK QUADRANGLE, WEST SUMATRA

By

Keith Robinson

U. S. Geological Survey

INTRODUCTION

This report is a brief description of the geology of the Solok quadrangle in West Sumatra. It is based on work done by the writer from April 27 to October 14, 1971, as part of the U. S. Geological Survey (USGS) Cooperative Project with the Geological Survey of Indonesia (GSI). The project is sponsored by the Government of Indonesia and the Agency for International Development, U. S. Department of State, and staffed by personnel of the USGS and counterparts of GSI.

The writer thanks the members of the field party for their contributions toward the success of the mapping program. The field party chief, P. H. Silitonga, Kastowo Soewitodirdjo, and geological assistant, T. O. Simandjuntak, deserve special mention, and Mr. Wikarno, Chief of the Petrology and Mineralogy Laboratory, was most helpful in arranging for the preparation of thin sections from field samples collected in Sumatra.

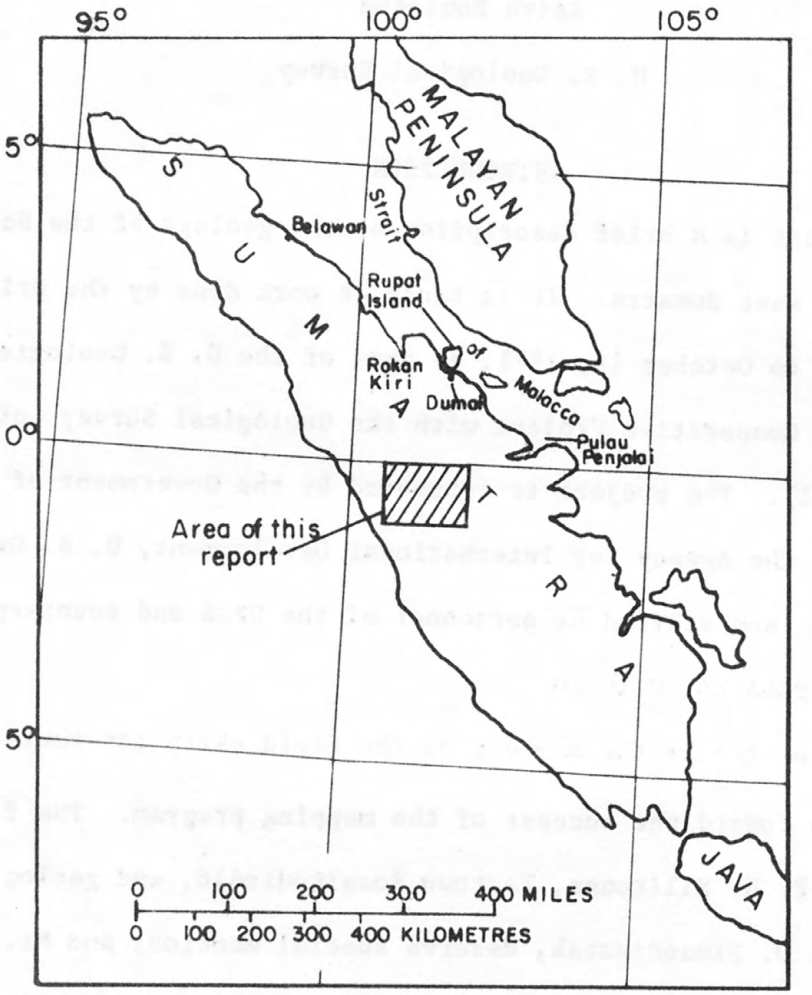

Figure 1a : Index map

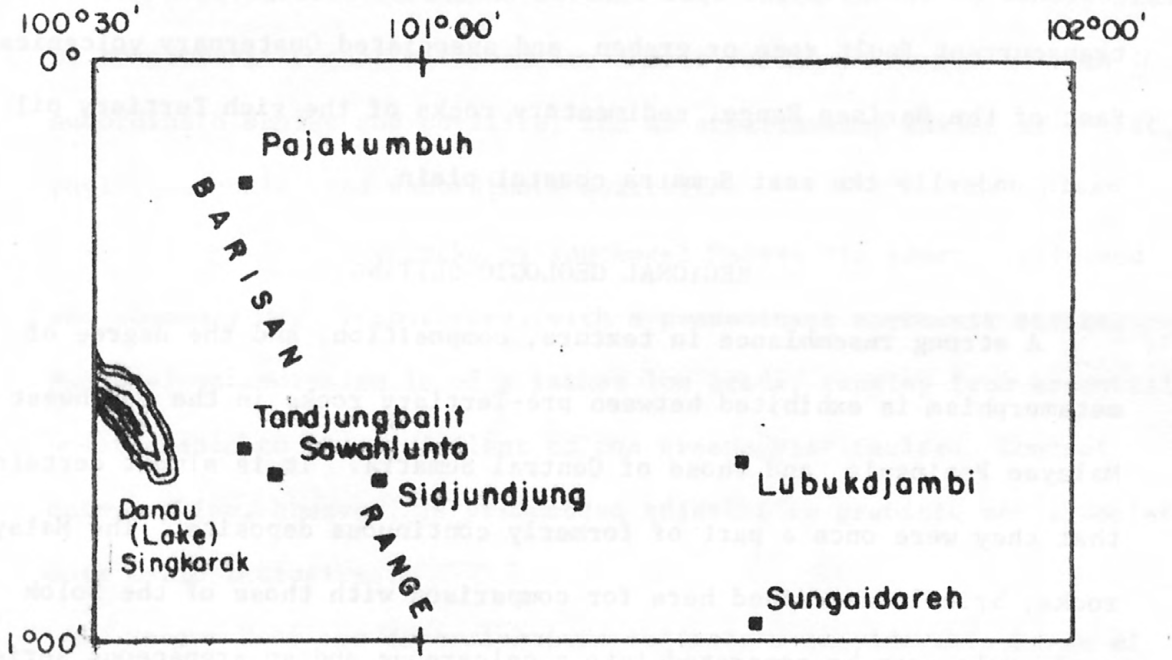

Figure 1b: Sketch map of Solok Quadrangle, Sumatra, Indonesia

The Solok quadrangle (figs. 1a and 1b), scale 1:250,000, is bounded by the equator and 1°00' south latitude and by 100°30' and 102°00' east longitude. Geologically the quadrangle encompasses a thick sequence of Paleozoic, Mesozoic, Tertiary, and Quaternary rocks. Tertiary sediments exposed on the west coast give way eastward to Paleozoic and Mesozoic metamorphic and intrusive rocks that form the backbone of the central Barisan Range geanticline with its large transcurrent fault zone or graben, and associated Quaternary volcanics. East of the Barisan Range, sedimentary rocks of the rich Tertiary oil basin underlie the east Sumatra coastal plain.

REGIONAL GEOLOGIC SETTING

A strong resemblance in texture, composition, and the degree of metamorphism is exhibited between pre-Tertiary rocks in the southwest Malayan Peninsula and those of Central Sumatra. It is almost certain that they were once a part of formerly continuous deposits. The Malayan rocks, briefly described here for comparison with those of the Solok quadrangle, can be separated into a calcareous and an arenaceous series. Both are generally unfossiliferous. The few fossils that have been found suggest that the calcareous series is late Paleozoic and that the arenaceous series is Triassic or early Mesozoic in age. Intercalated throughout both series are rhyolite, trachyandesite, and andesite tuffs, flows, and breccias that have been referred to collectively as the Pahang volcanics.

The calcareous series is divided into two facies—a calcareous facies consisting of limestone with interbedded quartzite, schist, phyllite, and shale; and an argillaceous facies of schist, phyllite, shale, and calcareous shale with minor amounts of intercalated quartzite and, rarely, chert beds.

The arenaceous series is divided into three facies--a pebbly facies of conglomeratic quartzite; an arenaceous facies of quartzite with subordinate schist and phyllite; and an argillaceous facies of schist, phyllite, shale, and subordinate quartzite.

The pre-Tertiary rocks of southwest Malaya are generally folded and commonly highly contorted, with a predominant northwest strike. Regional metamorphism is of a rather low grade, ranging from essentially undetectable to the equivalent of the greenschist facies. Contact metamorphism, however, is pronounced adjacent to granitic and associated more mafic intrusives.

Recent K-Ar age determinations indicate a considerable range of ages for the Malayan granites. Most determinations indicate Jurassic and early Cretaceous ages, but some are Triassic, one is approximately Permian, and another small group is early Cenozoic (Haile, 1967).

Tertiary rocks, like the pre-Tertiary, probably once extended continuously from Malaya across the Strait of Malacca to western Sumatra. The Strait of Malacca is known to contain a considerable thickness of Tertiary sedimentary rocks, probably in excess of 1300 meters, in the Belawan to Rupat Island area. The upper part of this deposit is generally considered to be of Pliocene age, based on scant paleontological evidence, and the lower part to be marine sediment of Miocene age. The east coast of Sumatra in the Rupat Island area is known to be bounded by a series of northwest-trending faults that generally parallel the coastline and are downthrown to the northeast, thus breaking the continuity of exposure. In the Dumai-Pulau Penjalai area of the east Sumatra coastal plain, pre-Tertiary rocks crop out or near the surface, but the Tertiary-pre-Tertiary contact dips westward, and in the Sungai Rokan-kiri area at least 3300 meters of Tertiary section is known. Farther west, uplift of the Barisan geanticline has interrupted the formerly continuous Tertiary deposits. Uplift is considered, on the basis of lithofacies studies, to have continued during much of Tertiary time, causing sediments to be draped relatively thinly over the crest of the rising geanticline, particularly Mio-Pliocene sediments, and then subsequently to be removed by erosion. The Umbilin basin in the Solok quadrangle is thus considered to be a remnant pocket of lower Tertiary rock that once probably blanketed all of the present Barisan Range. West of the Barisan Range, the Tertiary section again thickens toward the outer island chain.

SOLOK QUADRANGLE, PRELIMINARY OBSERVATIONS

East of an imaginary northwest-southeast line through Pajakumbuh and Sungaidareh, the pre-Tertiary rocks in the Solok quadrangle bear a strong resemblance to the calcareous series in Malaya. West of this line the rocks are more varied and resemble both the calcareous and arenaceous series in Malaya.

East of the Pajakumbuh-Sungaidareh line, megascopic features and preliminary thin-section observations suggest that the rocks comprise a miogeosynclinal suite. The quartzites are mature, clean, equigranular, and contain only minor amounts of other detrital components. The phyllite or phyllitic siltstone are primarily siliceous, and the limestone is mainly lithified calcareous muds; fossils are generally sparse but some beds contain sporadic fossils or fossil debris. A low-energy environment of deposition is suggested.

Although there is a dearth of useful fossils in this miogeosynclinal suite of rocks, one thin section of limestone from approximately 6 km north of Sidjungdjung displays numerous ovoid cross sections which have been identified as fusulinids. This establishes the limestone to be of Pennsylvanian or Permian age. In addition, Permian fusulinids were identified in a thin section of a limestone from approximately 10 km west of Pajakumbuh. This is on regional strike with the limestone of the miogeosynclinal suite near Sidjungdjung. Extensive collections should be made from these areas which should be searched for conodonts and better preserved fusulinids.

The sequence of miogeosynclinal rocks is magnificently exposed in continuous sequence along the Kuantan River from Sidjungdjung to Lubukdjambi, an exposure of about 30 kilometers across the strike. The rocks are intruded by a porphyritic granite characterized by large phenocrysts of red microcline in a groundmass of quartz, oligoclase, and biotite, with minor accessory minerals. This granite closely resembles some phases of the Main Range granite in Malaya.

The miogeosynclinal rocks are generally strongly folded and locally display highly contorted recumbent and chevron-type folds, with associated small thrusts and faults. Regional dip appears to be to the northeast and at a relatively low angle, hence the superimposed concertina folding suggests considerable repetition of section. Treating the measured dips as a random sample and subjecting them to elementary vectorial analysis, the resultant vector dips between 6° to 10° northeast. Assuming this to represent regional dip, the true thickness of the 30 kilometers of rock exposed across strike would be 3000 to 5300 meters. This estimate is based on scant observations and not on a truly random sample. It is given, however, as a preliminary observation based on available data and is subject to change. Furthermore, the lesser thickness of 3000 meters is probably more realistic, allowing compensation for inclusion of the granite intrusive.

In general the degree of metamorphism is low, no greater than greenschist facies, except adjacent to granite and associated more mafic plutons where contact metamorphism is pronounced, and metallic mineralization, mainly sulfides and native copper, are locally present.

Re-entrant erosional features, the trace of the outcrop edge noted on aerial photographs, and lithologic evidence suggest the presence of a fault, possibly a low-angle thrust, along the southwestern basal edge of the limestone pinnacles exposed along the road between Sidjungdjung and Sungaidareh. Basal Tertiary conglomerates immediately adjacent contain no limestone pebbles, as would be expected, if the limestone had been in its present position at the onset of Tertiary sedimentation. Thus it is likely that rocks of the miogeosynclinal sequence, forming the upper and eastern plate of the thrust sheet, have been transported westward(?) along a low-angle fault.

West of the Pajakumbuh-Sungaidareh line a complex association of pre-Tertiary rocks is similar to both the calcareous and arenaceous series of Malaya. The sequence has been intruded by silicic and mafic rocks that are accompanied by local mineralized zones. Rocks resembling the Triassic(?) arenaceous series in Malaya consist of argillaceous and siliceous phyllite, siltstone, and, on preliminary examination, quartzite of a slightly more "dirty," subgraywacke nature than those of the miogeosynclinal upper Paleozoic(?) sequence. Interbedded with them are tuffs and lava flows similar to the Pahang volcanics in Malaya. However, unlike the arenaceous series in Malaya, the Sumatran equivalents include conspicuous limestone units containing Triassic fossils (Musper, 1929). The rocks resembling the calcareous series of Malaya consist of limestone, quartzite, and phyllite with some fine-grained intrusives. These rocks form isolated outcrops, and the limestone in places is strongly recrystallized and silicified. Near Lake Singkarak, Musper (1929) identified Permian fossils in some of the limestones, and this age has been substantiated by the identification of Permian fusulinids.

Although they have not been identified as to species, abundant brachiopods were found in limestones identified by Musper as Triassic, and corals and crinoidal debris were found in limestones identified by him as Permian. Further interpretation of the pre-Tertiary rocks must await identification of the fossils collected during this survey and study of the thin sections.

The main igneous bodies in the Solok quadrangle must have been intruded in post-Triassic, pre-Oligocene time, for Triassic rocks are cut by the intrusives, and basal Tertiary sediments of probable Oligocene age locally contain pebbles of the intrusives and are nowhere known to be intruded by plutonic rocks.

The Tertiary section near Sawahlunto, in the Umbilin basin area of Central Sumatra, consists of a basal series of conglomerate and sandstone, overlain in succession by coal beds and shale containing limestone nodules; glauconitic and calcareous sand and shale with associated limestone bands; and a monotonous sequence of sand, shale, siltstone, and clay. The basal sequence together with the overlying coal and shale were probably deposited in a lacustrine to swampy deltaic environment. The glauconitic sand and shale, with associated limestone, are marine and contain abundant fossils sporadically distributed throughout. Tentatively identified are echinoids, gastropods, and abundant Foraminifera, including species of Textularia, Globigerina, Rotalia, Orbulina, Ammodiscus, Bolivina, and Haplophragmoides. The overlying sequence of sand, shale, siltstone, and clay characterized by very clayey sand, high concentrations of carbonaceous material, lignite beds, lack of limestone and marine fossils, indicate a nonmarine to brackish-water environment of deposition.

The Tertiary section in the Umbilin Basin is at least 700 meters thick, based on exploratory coal drilling, and is similar to the section established by drilling in the main Tertiary basin to the east, where the rocks range from Oligocene to Pliocene in age.

Ripple marks indicate that water incursion was from the west and northwest and that onlap of Tertiary sediments on the underlying pre-Tertiary surface and marine inundation started in the west.

Dips in the Tertiary sedimentary rocks of west Sumatra are quite variable, ranging from a few degrees to almost vertical. Faulting is common. In no place was the Tertiary section seen to be intruded by plutonic igneous bodies. However, fine-grained hypabyssal rocks and lava flows were found in close proximity to Tertiary conglomerate north east of Pajakumbuh, but their exact relationship has not yet been determined. Several volcanic breccias, interbedded with Tertiary strata, establish volcanic activity within the depositional basin during Tertiary time.

The most impressive exposure of Tertiary rock is on Gunung Papan, east of Lake Singkarak and adjacent to Tandjungbalit. The whole mountain is composed of a massive conglomerate, cemented by a limestone matrix, and grading in places into pure limestone. The basal part of the conglomerate consists primarily of limestone boulders as much as 2 feet in diameter and contains only a few quartzite boulders. Higher in the conglomerate section, granite, quartzite, and volcanic boulders are relatively abundant. This conglomerate records the uplift of the pre-Tertiary sediments in the Barisan geanticline during the Tertiary Period, accompanied by the sequential erosion, first of the limestone, then of underlying quartzite, and finally, of the granite core.

MINERAL DEPOSITS OF POSSIBLE ECONOMIC IMPORTANCE

Several mineralized zones of possible economic importance were observed during the field mapping. Of particular interest is an iron-rich unit just east of Duriangadang on the Kuantan River. Limonite and hematite characterize this unit, which is estimated to be at least 100 meters thick. It appears to be an iron-oxide-rich sedimentary unit interlayered with quartzite in a sequence of limestone, quartzite, and phyllite.

Approximately 2 km northwest of Silungkang, in the Sawahlunto area, a vein about 1 meter wide was observed to contain chalcopyrite, other sulfide minerals, and native copper.

Both areas should be examined using geochemical exploration prospecting techniques.

REFERENCES CITED

Haile, N. S., 1967, Discussion in reply to J. A. Katili (1967), Structure and age of the Indonesian tin belt with special reference to Sumatra: Tectonophysics, v. 4, no. 4-6, p. 403-418.

Musper, K. A. F. R., 1929, Jaarboek Van Het Mijnwegen in Netherlands Indies.


WERT
BOOKBINDING
MIDDLETOWN, PA.
JANUARY 75
We're Quality Bound

USGS LIBRARY-RESTON
3 1818 00076971 9