Geological Branch Summary Of Activities, 1977

11 Structural geology of Thailand during the Cenozoic

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This chapter begins with a brief review of the data available for understanding the Cenozoic deformation of Thailand and a description of the different Cenozoic structural provinces of the country. The two dominant Cenozoic structural styles present in Thailand are strike–slip faulting (found predominantly in the western half of onshore Thailand and the Andaman Sea) and extension; folds, thrusts and inversion structures are also present in places (Fig. 11.1). The timing of deformation (Fig. 11.2) and typical structural styles present in outcrop and the subsurface are described. Particular attention is paid to the inheritance of fabrics on later fault geometries, since these are very distinctive and well developed in many areas.

The structural geology of Thailand is very important for understanding Cenozoic orogenic processes marginal to the Himalayan orogen. For those less interested in regional tectonics, there are also individual examples of structures that are outstanding and could grace any structural geology textbook, including:

(1) A beautifully documented opencast coal mine (Mae Moh, Fig. 11.1) 3 × 4 km in area, that reveals Miocene rift-related normal faults.
(2) Extensively developed and large-scale strike–slip fault zones with multiple strike–slip duplex geometries. Cenozoic mid-crustal level mylonites and migmatites are exposed in places, with recently described outcrops along the Ranong Fault (Watkinson *et al.* 2008) that rival the Red River–Ailao Shan Fault Zone in scale.
(3) The best examples seen anywhere on seismic reflection data of extensively developed, linked, high-length: displacement ratio normal faults (Gulf of Thailand).
(4) Abnormally deep (6+ km), high-subsidence rate post-rift basins that challenge our understanding of simple rift to post-rift basin subsidence mechanisms (Morley & Westaway 2006).

Modern tectonic setting of Thailand

Detailed discussion of the regional tectonics is given in other chapters, in particular Barber *et al.* (2011) and Searle & Morley (2011). Here a very brief review of the tectonic setting is necessary to place Cenozoic structural development in a regional context (Figs 11.3 & 11.4). Thailand is located at the northern end of the continental crustal core of SE Asia called Sundaland (Fig. 11.3), which is composed of a series of terranes that were rifted off Australia–Antarctica and re-assembled on the Asian margin by collisional events during the late Palaeozoic–Triassic (e.g. Metcalfe 2002). Global Positioning Satellite (GPS) data have confirmed that present day Sundaland is moving approximately as a single block (Simons *et al.* 2007). There is a sharp transition in movement direction and velocity between Thailand/eastern Myanmar across the north–south trending Sagaing Fault (Fig. 11.5) and western Myanmar. The Sagaing Fault is one of the largest and most active strike–slip faults in the world, with dextral motion of the order *c.* 2.4 cm a^{-1} (Vigny *et al.* 2003; Curray 2005). The motion accommodates about two-thirds of the northwards motion of India relative to Indochina. A less dramatic boundary, apparent from the GPS data, lies between northern Thailand and the Yunnan/Golden Triangle area to the north (Simons *et al.* 2007; Fig. 11.5). In Figure 11.5 the marked north–south change in velocity occurs across the Ailao–Shan–Red River Fault and a series of ENE–WSW trending sinistral strike–slip faults. Northern Thailand marks a region where the development of north–south to NE–SW trending basins commences and the prominent region of predominantly strike–slip seismicity diminishes. GPS data indicate that Thailand is moving as a single block today (Fig. 11.5).

For much of the Cenozoic, Sundaland has been the overlying plate to a great belt of subduction zones stretching from the Andaman Sea through Indonesia to the Philippines. The northern end of Sundaland has also interacted with the Indian Plate as it moved north to collide with Eurasia. Consequently, the structural evolution of Thailand during the Cenozoic reflects both subduction-related processes to the west and SW and the effects of the Himalayan Orogeny. Today Myanmar effectively forms a diffuse north–south striking transform plate boundary defined by the dextral Sagaing Fault and the Andaman Trench (Fig. 11.4). This boundary is due to the coupling of western Myanmar with the Indian Plate which is consequently being dragged northwards relative to Sundaland (see review by Curray 2005). Today, passing northwards from northern Thailand towards the southern margin of the East Himalayan syntaxis, there is increasing strike–slip fault-dominated deformation (Lacassin *et al.* 1998; Socquet & Pubellier 2005; Morley 2007) (Fig. 11.5).

The modern tectonic setting provides a snapshot in time of a rapidly evolving region. To determine the evolution of Thailand during the Cenozoic, it is necessary to establish the timing and kinematics of deformation, metamorphic history, cooling history and sedimentary basin evolution. Our understanding of these aspects has significantly improved over the last 10–15 years due to increasing availability of coal and oil industry data, improved radiometric dating techniques and new outcrop studies from coal mines where the deformation of Cenozoic sediments can be seen in context.

REPORT Geological Branch. Summary of Activities \j. .. around the Woodlawn deposit, which was described in the Summary of.Available in the National Library of Australia collection. Author: Australia. Bureau of Mineral Resources, Geology and Geophysics; Format: Book; ix, , a48 p.Geological Fieldwork: A Summary of Fieldwork and Current Research, is It contains reports of Geological Survey Branch activities and projects during.Free on application to Branch of Distribution, U.S. Geological Survey Integration of results of the geologic studies with existing data and summary of geologic and hydro coal bed mining activity and mine-subsidence incidents __ _ _ .. vicinity, Pennsylvania description of a pro- gram and its results by R. P. Briggs. the Mineral Deposits Section, Geological Branch, as Resident Geologist at. Sudbury. A summary of fiscal year MEAP activities is given in OFR.A summary of known mineral exploration activity . A summary of MEAP activities in the fiscal year . Field Work, , by the Geological Branch, edited by. . /, Annual summary of activities Geological Branch /, Shallow., Geological Branch summary of activities , An integrated scheme for the laboratory analysis of oil, natural gas, and petroleum source-rocks.Brakel and Muhling, Explanatory Notes, 1/ geological series, Sheet SH/ Geol. Surv .. Geological Branch, Summary of Activities, , Bur.These volumes represent a summary of the yearly activities and scientific research for the Geological Survey, published in March of each year.SUMMARY OF ACTIVITIES DURING Data and Assistance. The Geological Survey Branch sells geological maps and publications, maintains.Open File Report (OF) current Information on specific geological an annual summary report of field activities carried out by the Geological Services . Virden NTS 62F; Manitoba Energy and Mines, Mines Branch, [], NTS area 62F.of NTS 63P13 and 14); in Report of Activities , Manitoba Industry, Economic Development and east branch of Mystery Lake, but asymmetric folds may.(Record Group 57) (bulk) OVERVIEW OF RECORDS LOCATIONS. Records of the Alaskan Geology Branch .), to supervise activities of separate surveys then in progress and to centralize .. Water resource investigation index maps, showing locations of projects, (40 items).Waskaiowaka Lake area: In Manitoba Mines, Resources and Environmental Management, Summary of Geological Fieldwork. , Geological Mines, Geological Services. Mines Branch, Report of Field. Activities. , p. most of the state's exploration activity has been con- centrated. Areas of metallic mineral exploration in Washington, .. This concludes the summary of exploration purchased for $2 each, prepaid, from the Branch of.The Idaho Geological Survey is the special public service and research agency Inc., Earth and Life Sciences and Energy Programs Branch, DOE/ID, p. , Summary of geothermal drilling activity in the western states, and .Geology is an earth science concerned with the solid Earth, the rocks of which it is composed, .. events are often also associated with volcanism and igneous activity. . Surface of Mars as photographed by the Viking 2 lander December 9, Economic geology is an important branch of geology which deals with.Teachers and Faculty Scientist Engagement Education Activity Directory About Us

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