The great Sunda–Pacific volcanic arcs

One of the world’s great Cainozoic volcano-plutonic arcs characterizes the convergent plate margin of the Indian Plate against Eurasia, and the marginal seas that characterize the South-west Pacific. Together, they form a nearly continuous arc from the Andaman Sea, along the margins of Sundaland, to the northern Australian margin, then northwards through the Philippines to Okinawa. On the Indian side, the arc has resulted from subduction of the India–Indian Ocean–Australia Plate. Before continental India began its collision with Eurasia to form the Himalayas, there was pre-Eocene subduction of oceanic lithosphere beneath Tibet to form the Gandise arc, which abruptly terminated with the arrival of the Indian Platform at the subduction zone. The Burman Volcanic Arc was active until subduction ceased along the Indo-Burman Ranges former trench location. Southwards from Myanmar, oceanic lithosphere of the Indian Ocean continues to subduct beneath Sundaland (Fig. 2.21), and the Indonesian Volcanic Arc is continuous from Sumatra, through Java to Flores. North of Timor, there is an extinct and uplifted sector of the arc from Alor to Romang, because of the arrival of continental Australia at the subduction zone, but activity continues eastwards in the Banda Arc, though the volcanic rocks show geochemical evidence of under-thrust Australia. Most of this eastern sector will progressively extinguish as Australia pushes northwards.

On the Pacific side, the great volcanic girdle continues northwards from Halmahera and Sangihe through the Philippines, where the arcs are related to subduction of the marginal sea lithosphere of the Celebes, West Philippine Basin, and South China Sea Basin. Opposing directed subductions are in the process of active reorganization, and the volcanic arcs will change in time and place. The Taiwan sector is extinct because of the underthrust continental shelf of China, but eastwards the West Philippine Basin lithosphere subducts at the Ryukyu Trench to give the active Okinawa volcanic arc.

8.1. GANDISE ARC OF THE INDUS–ZANGBO–YARLUNG SYSTEM

The volcano-plutonic arc occupies southern Tibet along the Gandise–Nyainqentangha Mountain Range (Fig. 9.1). Its eastern end turns south-east at Chayu, and in the west it extends to Ladakh in Kashmir, being 1000 km east-west and about 100 km north-south (Geological Bureau of Xizang 1982).

The arc plutonic part comprises the huge Gandise intermediate to acid intrusive complex (Chapter 9), and the volcanic part comprises intermediate-acid volcanic rocks of the Upper Jurassic–Lower Cretaceous Sangri Group and the widespread Cretaceous–Tertiary Linzizong Formation volcanic series. The plutonic and volcanic rocks are closely associated, comprising a range from andesite diorite, granodiorite and granitoids, and andesite, dacite, rhyolite, and trachyte.

The Sangri Group volcanic rocks are associated with a sequence of Late Jurassic to Early Cretaceous neritic carbonates and clastic sediments. It is chiefly composed of andesite, dacite, keratophyre, and a huge amount of andesitic and dacitic crystal tuff, volcanic breccia, and other pyroclastic varieties. The chemistry suggests an island-arc calc-alkaline series.

The Linzizong Formation unconformably overlies a sequence of folded Late Cretaceous red clastic rocks. Below the volcanic rocks is 50–60 m thickness of conglomerate on the Qinghai–Tibet Highway, 40 km north of Lhasa (Geological Bureau of Xizang 1982). The Linzizong Formation is largely of lava and tuff, intercalated with continental clastic strata. The Linzizong Volcanic Series is over 2500 m thick, composed mainly of andesite-dacite-rhyolite lavas and pyroclastic rocks, lying unconformably on shale of the Late Cretaceous Tanka Formation (Wang 1984).

There are three major cycles, each one dominated by andesite and andesitic pyroclastic rocks in the lower part, and by dacite and rhyolitic pyroclastic rocks, and tuffaceous sandstone and conglomerate in the upper part. Cycle I is up to 966 m thick. The lower part is of a spectrum from tholeiitic, through calc-