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Magmatic switch-on and switch-off along the South China continental margin since the Permian: Transition from an Andean-type to a Western Pacific-type plate boundary

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ABSTRACT

Detrital zircon provenance data for the Tananao schist in eastern Taiwan is consistent with its protolith being deposited on the South China continental margin at around, or soon after, 150 Ma, rather than being of an exotic origin and much older as previously suggested. The absence of ca. 200 Ma zircons agrees with the presence of a magmatic gap in the region after the orogenic and magmatic front migrated to central South China, due to a flat-slab subduction. The characteristic lack of input from interior South China (i.e., the lack of 1100–750 Ma and 470–420 Ma populations), and the immature nature of some of the schist units, suggest that they were sourced from the nearby coastal regions. On the other hand, they exhibit a dominant 190–150 Ma magmatic zircon population, suggesting the presence of abundant magmatic rocks of that age along the coastal regions. This, along with our newly discovered ca. 180 Ma I-type granites from eastern Zhejiang and other ca. 190–180 Ma magmatic rocks recently reported from the coastal regions, led us to propose that a new continental arc was initiated after ca. 190 Ma along the coastal region after a magmatic gap due to flat-slab subduction. This newly initiated arc likely persisted until ca. 90 Ma, and is represented by the I-type granitic rocks in eastern Taiwan. Slab roll-back likely caused the arc system to retreat towards the Pacific Ocean after 90 Ma, and ca. 60–17 Ma bimodal magmatism adjacent to the South China Sea signifies continental margin extension in the lead-up to, and during, the opening of the South China Sea. We thus argue that the continental margin of East Asia was transformed from an Andean-type plate margin at 280–90 Ma, to the present-day Western Pacific-type plate margin soon after 90 Ma.

1. Introduction

Typical active continental margins include Andean-type margins featuring the development of continental arcs, and Western Pacific-type margins featuring the development of marginal oceanic basins between the continents and island arcs. Each margin type possesses different magmatic characteristics: Andean-type active margins develop continental magmatic arcs with magmatic gaps above flat-slab or ridge subduction (Ramos, 1999; Ramos and Aleman, 2000), and Western Pacific-type active margins have the continental margins separated from active magmatic island arcs by marginal seas. Questions remaining to be answered include: (1) since when the Western Pacific-type active margin has existed in the Western Pacific, (2) was there ever an Andean-type active margin, or even a passive margin, before the development of the Western Pacific-type active margin there, and (3) if the answer to question 2 is yes, what tectonic processes may have caused such changes?

The Australia–Antarctica section of the Western Pacific continental margin evolved from a dominantly Andean-type active margin between late Devonian and mid-Cretaceous to a Western Pacific-type margin after that time (Li and Powell, 2001). However, how the nature of the continental margin evolved in the northwest Pacific margin remains unclear. The East Asian continent to the northwest of the Pacific Ocean consists of Siberia, Mongolia, North China, South China and Indochina blocks, accreted together between the Permian and the Early Cretaceous through the closure of a series of Tethyan oceans (Li and Powell, 2001; Metcalfe, 1996; Scotese, 2004). It was traditionally believed that an Andean-type active continental margin started to exist along the present southeastern margin of the South China Block from Triassic–Jurassic and lasted to mid-Cretaceous, as

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demonstrated by the development of a broad continental magmatic arc there (e.g., Cui and Li, 1983; Jahn et al., 1990; Klimetz, 1983; Zhou and Li, 2000) (Fig. 1), although it was speculated, largely based on the record of the Japanese islands, that the subduction could have started as early as late Carboniferous or Permian (Faure and Charvet, 1987; Maruyama et al., 1997). Li et al. (2006) documented the first solid evidence for the starting up of continental arc magmatism along coastal South China at mid-Permian (ca. 265 Ma).

Li and Li (2007) demonstrated that like the present-day Andes margin, the Permian–Cretaceous Andean-type continental margin

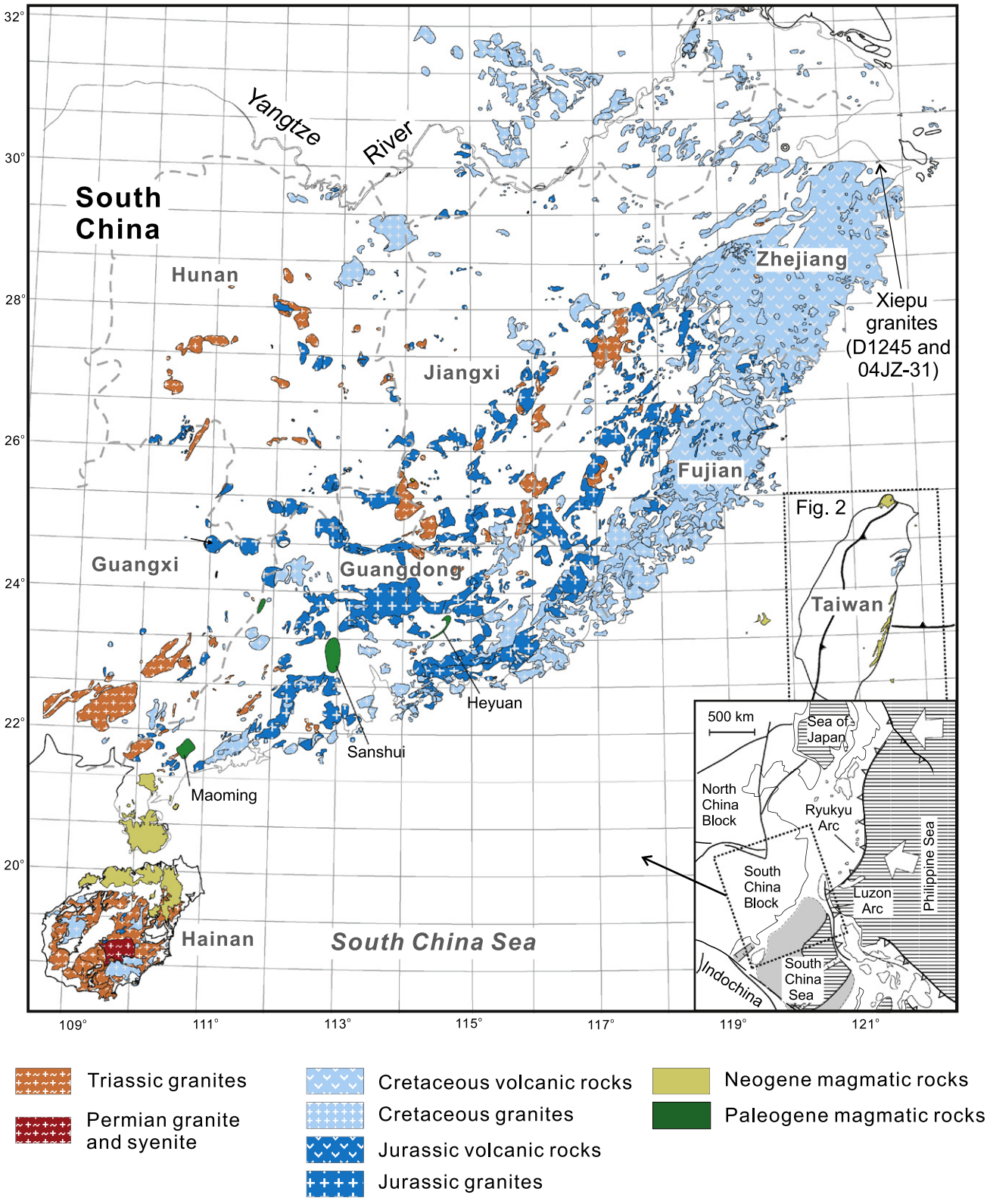

Fig. 1. Post-Carboniferous magmatism along the coastal region of East Asia, showing location of the Xiepu granites (modified after Li et al., in press). Data for Taiwan are after Chung et al. (1995).