

Transition between the Okinawa Trough Backarc Extension and the Taiwan Collision: New Insights on the Southernmost Ryukyu Subduction Zone

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(Received 10 April 1995; accepted 18 July 1995)

Key words: Arc-arc collision, backarc extension, along-axis propagating trench, trench segmentation, Gagua ridge, Luzon arc, Taiwan, Okinawa trough.

Abstract. Located between the Okinawa trough (OT) backarc basin and the collisional zone in Taiwan, the southernmost Ryukyu subduction zone is investigated. This area, including the southwestern portions of the OT and Ryukyu island arc (RA) and located west of 123.5° E, is named the “Taiwan–Ryukyu fault zone” (TRFZ). West of 123.5° E, the OT displays NNW–SSE structural trends which are different in direction from the ENE–WSW trending pattern of the rest of the OT. Using joint analysis of bathymetric, magnetic, gravity and earthquake data, three major discontinuities, that we interpret as right-lateral strike-slip faults (Faults A, B and C), have been identified. These faults could represent major decouplings in the southern portion of the Ryukyu subduction zone: each decoupling results in a decrease of the horizontal stress on the portion of the RA located on the eastern side of the corresponding fault, which allows the extension of the eastern side of OT to proceed more freely.

We demonstrate that the 30° clockwise bending of the southwestern RA and the consecutive faulting in the TRFZ are mainly due to the collision of the Luzon arc with the former RA. After the formation of Fault C, the counterclockwise rotated portion of the ancient RA located west of the Luzon arc was more parallel to the Luzon arc. This configuration should have increased the contact surface and friction between the Luzon arc and the ancient RA, which could have reduced the northward subduction of the Luzon arc. Thus, the westward component of the compressive stress from the collision of the Luzon arc should become predominant in the collisional system resulting in the uplift of Taiwan. Presently, because the most active collision of the Luzon arc has migrated to the central Taiwan (at about 23° N; 121.2° E), the southwestern OT has resumed its extension. In addition, the later resistant subduction of the Gagua ridge could have reactivated the pre-existing faults A and B at 1 M.y. ago and present, respectively. From 9 to 4 M.y., a large portion of the Gagua ridge probably collided with the southwestern RA. Because of its large buoyancy, this portion of the ridge resisted to subduct beneath the Okinawa platelet. As a result, we suggest that a large exotic terrane, named the Gagua terrane, was emplaced on the inner side of the present Ryukyu trench. Since that period, the southwestern portion of the Ryukyu trench was segmented into two

parallel branches separated by the Gagua ridge: the eastern segment propagated westward along the trench axis while the western segment of the trench retreated along the trench axis.

1. Introduction

The Okinawa trough (OT), located landward the Ryukyu island arc (RA), is a backarc basin developed in a continental domain (Figure 1) (Lee *et al.*, 1980; Letouzey and Kimura, 1985; Sibuet *et al.*, 1987). Because the OT terminates at the western limit of the Ilan plain (northeastern Taiwan), where the Lishan fault begins (Figures 1 and 2b), the initial formation of the OT was therefore frequently considered to be associated with the collisional process in Taiwan (Letouzey and Kimura, 1985; Suppe, 1984; Teng, 1990; Angelier, 1990). In other words, previous interpretations were based on an arc-continent collision model which suggests a continuous evolution from a compressional regime to an extensional regime, such as the lateral extrusion model of Letouzey and Kimura (1985). However, the existence of NS structural discontinuities found in the Ilan plain (Hsu *et al.*, 1996) raises fundamental questions about the collision-controlled models of the OT opening. A recent arc-arc collision model, proposed by Hsu and Sibuet (1995) and Hsu *et al.* (1995), suggests that a former subduction zone extended from southwestern Taiwan to southern Japan prior to the uplift of Taiwan. In this hypothesis, Taiwan mountain building started after the closure of the oceanic domain located between the Luzon arc and the former RA. The Hsüeshan and the Backbone ranges, located on the western and eastern sides of the Lishan fault respectively, are therefore interpreted as the closure of a former backarc basin and the Tananao complex as part of the former Ryukyu arc.