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A DETAILED INVESTIGATION OF THE YAP TRENCH: EVIDENCE FOR CHANGE IN THE STYLE AND TIMING OF COLLISION BETWEEN THE CAROLINE RIDGE AND PHILIPPINE SEA PLATE

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The Yap Trench is one of the arc-trench systems that comprise the eastern boundary of the Philippine Sea Plate. It is located at the southwestern end of the Mariana Trench where the Pacific Plate is subducting beneath the Philippine Sea Plate. One of the unique features of the Yap Trench is that it has a short arc-trench distance compared to other arc-trench systems. In the case of the Yap Trench this distance is only 50 km. The proximity is most likely a consequence of collision of the trench with the Caroline Ridge, a NW-SE trending region of topographic highs and lows produced by the movement of Caroline and Pacific Plates over the Caroline hotspot. Sorol Trough, a long wedge-shaped basin, divides the Caroline Ridge into north and south segments. Previous models suggest that the Caroline Ridge as a whole came into contact with the Yap Trench at around 25-24 Ma. However, a detailed examination of bathymetry, multi-channel seismic and satellite gravity data suggests that the collision occurred in a quite different manner on either side of the Sorol Trough along 9°N. The new data also raises questions as to the timing of the collision. Several observations suggest that the southern half of the Caroline Ridge has collided head on with Yap Trench, but the northern half has not. According to our Bouguer gravity anomaly map, a large negative anomaly is present over the arc region south of 9°N. This is probably due to thickened arc crust. However, such a feature is not found on the arc to the north of 9°N. Although its origin is still in doubt, a piece of low-relief seafloor exists only on the seaward side of the trench on the northern Caroline Ridge (9°N-10°45′N). Also there is a notable difference in the morphological complexity between the northern and southern segments of Caroline Ridge. Finally, a recent geodetic measurement using a GPS network shows that the northern Caroline Ridge is converging obliquely with Yap Island. In the light of these new observations, we propose a revised model for the collision between the Caroline Ridge and Yap Trench. In our model, the Caroline Ridge originally formed at 28.5-27 Ma but was then divided into north and south by spreading along the Sorol Trough. The collision of Caroline Ridge with the Yap Trench probably began at around 19-15 Ma. The style of collision was different on either side of Sorol Trough. In the south, the Caroline Ridge came into contact with the trench and pushed west, causing tectonic erosion of the forearc region. To the north, continued opening of the Sorol Trough moved the Caroline Ridge north, where it eventually collided obliquely with the south tip of the remnant arc of the Parece Vela Basin. This oblique convergence probably caused the topography of the northern Caroline Ridge to become more corrugated than that to the south.