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South China Sea Crustal Thickness and Oceanic Lithosphere Distribution from Satellite Gravity Inversion

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ABSTRACT

The distribution of oceanic crust and lithosphere within the South China Sea (SCS) are controversial. We use 3D gravity anomaly inversion to map Moho depth, crustal basement thickness and continental lithosphere thinning for the SCS in order to determine COB location, OCT structure and the distribution of oceanic lithosphere. Because of the young formation age of the SCS it is essential that the gravity inversion method incorporates a lithosphere thermal gravity anomaly which for much of the SCS exceeds -100 mgal in magnitude. The gravity inversion method provides a prediction of ocean-continent transition structure and continent-ocean boundary location which is independent of ocean isochron information. Gravity inversion shows that SCS conjugate margins are highly asymmetric and have several striking features such as the Macclesfield Bank, Xisha Trough, Reed Bank and Dangerous Grounds. Thin continental crust is predicted extending westwards from thin oceanic crust north of Macclesfield Bank into the Quiondongnan (QDN) basin and is interpreted as being generated ahead of westward propagating sea-floor spreading in the Oligocene. Further south, highly thinned continental crust or possibly serpentinised exhumed mantle is predicted in the Phu Khanh Basin. Ahead of the failed propagating tip of seafloor spreading, offshore southern Vietnam, thinned continental crust is predicted for the Cuu Long and Nam Con Son Basins. Crustal thicknesses from gravity inversion confirms that the southern margin of the SCS consists of fragmented blocks of thinned continental crust separated by thinner regions that have undergone higher degrees of stretching and thinning. The Reed Bank is predicted to have a crustal thickness of 20 to 25km, similar to that of Macclesfield Bank. The Dangerous Grounds, west of the Reed Bank, are predicted to be underlain by crust with thickness ranging between 10 and 20km thick. Using crustal thickness and continental lithosphere thinning factor maps with superimposed shaded-relief free-air gravity anomaly, we improve the determination of pre-breakup rifted margin conjugacy, rift orientation and sea-floor spreading trajectory. We use maps of crustal thickness and continental lithosphere thinning from gravity inversion together with free-air gravity and magnetic anomaly data to identify structural-tectonic trends. Pre-breakup rifting and early sea-floor spreading had a ENE-WSW trend while later sea-floor spreading had a NE-SW trend.