Geophysical Research Abstracts
Vol. 20, EGU2018-8652, 2018
EGU General Assembly 2018

Subduction-related continental rifting and microcontinent formation

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Continental rifting sometimes results in the formation of microcontinents and continental fragments. A microcontinent is a block of continental crust completely surrounded by oceanic lithosphere,. Classical examples are the Jan-Mayen Microcontinent in the NE Atlantic and the Seychelles in the Indian Ocean. A continental fragment is still attached to its parent continent by highly extended crust which failed to break-up. Examples are fragments off the west coast of Ireland associated with the opening of the NE Atlantic. Proposed scenarios for the formation of microcontinents and continental fragments are mostly associated with rifted continental margins, where rifting followed by seafloor spreading and mid-ocean-ridge relocation can result in the isolation of continental blocks and thus the formation of microcontinents. However, subduction processes can also result in microcontinent and continental fragment formation but the processes involved in their creation are not properly understood so far. Among microcontinents formed in subduction settings are the Corsica-Sardinia block in the Central Mediterranean, the Louisiade Plateau off the NE coast of Australia, and the Macclesfield and Reed Banks in the South China Sea.

Using publicly available geophysical and geological data we first review the tectonic structure of microcontinents and conjugate margins. In particular, we analysed the structure of rifted margins by inspecting their geophysical signature from gravity and magnetic data. Observations of bathymetry profiles, where sediment thickness has been subtracted, and Bouguer gravity anomalies show an asymmetry in widths of the margin and the Continent Ocean Transition of these rifted conjugate margins.

We then revisit the plate kinematics of regions where microcontinents formed in subduction-related settings with the aim to explain why microcontinents and continental fragments form in some areas and not in others. From our examples we find that microcontinents and continental fragments are associated with a component of rotation and/or oblique basin opening. The Central Mediterranean is characterised by a large 50° CCW rotation of the Corsica-Sardinia block due to Calabrian slab rollback which triggered rifting in the Liguro-Provençal Basin. In the South China Sea, rifting due to the southward subduction of the Proto-South China Sea propagated towards the SW resulting in a V-shaped basin. The evolution of the Coral Sea is thought to be controlled by the interplay between the northward motion of the Australian plate and the counterclockwise rotation of the Pacific plate. This triggered rifting and seafloor spreading NE of Australia resulting in the detachment of several microcontinents, including the Louisiade Plateau. Our preliminary analysis points towards the importance of small, enclosed basins as the locus of microcontinent formation in subduction settings and of rotational motions that allow separation of microcontinents from the parent continent.