Structure and Kinematics of Segment-Scale Crustal Accretion Processes in Iceland and Implications for Analogous Mid-Ocean Ridge Systems

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The kinematics of extensional tectonic systems define the structure of the crust that is created during rifting. Features such as structural basins, folds, faults and accommodation zones are important to understanding, among other things, the economic potential of such systems. Because of the segmented nature of rifts analysis at several scales is required in order to develop a model that accurately describes the mechanics of rifting and the structure of the resulting crust. The Skagi Peninsula region of northern Iceland is a natural laboratory that allows for structural analysis of crust that was accreted to Iceland ~7 Ma and subsequently glacially eroded, exposing 2-3 km of structural relief. At the finest scale, volcanic centers on the order of 5-10 km in diameter undergo focused local subsidence as evidenced by dense cone sheet swarms, flexural basins and calderas. These features indicate that 1-4.5 km of accommodation is created by subsidence beneath volcanic centers. At a larger scale, each volcanic center is part a volcanic system, defined by the center itself and fissure swarms extending for several 10's of km along the strike of the rift. Structural patterns vary significantly between volcanic centers and fissure swarms. While centers are characterized by focused sub-volcanic subsidence, fissure swarms are characterized by minor sub-axial subsidence and lateral dike intrusion. This indicates that along-strike relocation of magma and possibly deeper, middle crustal material are important crustal accretion processes. Each volcanic system is a structurally discrete interval of the Icelandic plate spreading axis. As a result of west-northwestward movement of Iceland relative to the Iceland hotspot, the spreading axis has progressively relocated to the east-southeast leaving a series of abandoned spreading axes throughout western Iceland. A synformal axis, created by the opposing sub-axial dip of lava sequences indicates that one of the abandoned spreading axes probably runs through the western part of the Skagi Peninsula region. Ur-Pb in zircon dating of rhyolitic and granophyric units from volcanic centers will constrain the timing of activity of the volcanic systems throughout western Iceland. This will allow for more precise and accurate constraints on the activity and relocation of the spreading axis in both space and time. The structure and kinematics of rifting and crustal accretion in Iceland are not only analogous to mid-ocean ridge spreading systems but also volcanic rift and rifted margin systems, where some significant recent petroleum discoveries have been made