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Variation of the tectono-magmatic activity along the Reykjanes Ridge: Influence of the Iceland hotspot on the accretionary processes

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The Reykjanes Ridge is a 900 km long oblique slow-spreading ridge, formed by individual “en echelon” axial volcanic ridges (AVR), directly under the influence of the Iceland hotspot. From the Reykjanes Peninsula to the Bight fracture zone, the Reykjanes Ridge shows variations in lava chemistry, crustal thickness, thermal structure and ridge morphology, which has been attributed to this influence. Our study focuses on four areas of the ridge mapped and sampled during the cruise MSM75 in 2018. The northern area is characterized by the only known hydrothermal field discovered along the Reykjanes Ridge. The two central areas are located in a region of increasing magma supply. Finally, the southernmost area is underlined by the only magma body ever detected seismically below the Reykjanes Ridge. The analysis combines 15 m resolution ship-based bathymetry, ground-truthing from ROV dives and geochemical analysis of glass samples to look at variations of magma composition, fault density, seamount density and morphology along the ridge axis. Two major parameters influence the distribution and geometry of faults and seamounts: the distance from the hotspot and the accretion state of individual AVR (i.e., magmatic extension vs. tectonic extension). Fracture geometry is highly influenced by the depth of the brittle-ductile boundary that deepens with distance from the plume center, while fault density at the axis reflects different development stages of individual AVR. Seamount morphologies may also reflect individual AVR development, but we also show morphological variation with distance from the hotspot, correlated with the average variation in lava composition and mantle temperature.