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Magmatism and deformation during continental breakup

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The rifting of continents and the transition to seafloor spreading is characterised by extensional faulting and thinning of the lithosphere, and is sometimes accompanied by voluminous intrusive and extrusive magmatism. In order to understand how these processes develop over time to break continents apart, we have traditionally relied on interpreting the geological record at the numerous fully developed, ancient rifted margins around the world. In these settings, however, it is difficult to discriminate between different mechanisms of extension and magmatism because the continent–ocean transition is typically buried beneath thick layers of volcanic and sedimentary rocks, and the tectonic and volcanic activity that characterised breakup has long-since ceased. Ongoing continental breakup in the African and Arabian rift systems offers a unique opportunity to address these problems because it exposes several sectors of tectonically active rift sector development spanning the transition from embryonic continental rifting in the south to incipient seafloor spreading in the north. Here I synthesise exciting, multidisciplinary observational and modelling studies using geophysical, geodetic, petrological and numerical techniques that uniquely constrain the distribution, time-scales, and interactions between extension and magmatism during the progressive breakup of the African Plate. This new research has identified the previously unrecognised role of rapid and episodic dike emplacement in accommodating a large proportion of extension during continental rifting. We are now beginning to realise that changes in the dominant mechanism for strain over time (faulting, stretching and magma intrusion) impact dramatically on magmatism and rift morphology. The challenge now is to take what we're learned from East Africa and apply it to the rifted margins whose geological record documents breakup during entire Wilson Cycles.