Magmatism At Rifted Margins: Oceanization Trigger?

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Research theme – scientific questions:
Although magmatic processes are of primary importance for the understanding of lithospheric breakup linking the transition from rifting to seafloor spreading, many first order questions remain, such as: how, when, where and how much magma is produced during final rifting? What are the conditions and controlling processes of magma production, how does magma percolate and interact with the overlying mantle and how and when does magma focus, how is it extracted and how does it interact with the extensional processes operating during breakup? Answering to these questions is a prerequisite to understand lithospheric breakup and formation of a new plate boundary, which is among the least understood plate tectonic processes at present.

Team of supervisors:
The team of supervisors is at the forefront of the research in rifting and early seafloor spreading. Their research builds on a description of natural examples onshore (fossil Alpine Tethys margins) and offshore (Ocean Continent Transitions (OCT) in the N-Atlantic and other global examples). The team combines structural, petrological, geochemical and geophysical methods to investigate the mantle and crustal rocks involved in lithospheric breakup and to link it to the sedimentary, isostatic and thermal evolution. Access to "new" samples dredged from the Diamantina zone (S-Australia) and the NW-Iberia margin, the involvement in IODP proposal 943 ("Continental breakup: the case for scientific drilling west of Galicia, Spain") and the access to a unique date collection from the fossil OCTs in the Alps and present-day Iberia-Newfoundland and Australia-Antarctica provide a research context that is unique and fertile, enabling to further develop one of the key research axes with international visibility of the ITES.

Research project:
The PhD project will include three actions that enable to respond to key scientific questions:

i) Establish the thermo-barometric conditions of melt production and percolation through mantle rocks at OCTs and define the source of melt (asthenosphere, fertilized and/or inherited Sub Continental Lithospheric Mantle or pyroxenite) with the aim to define the nature of melts and their chronology of emplacement. Methods used: µXRF, (LA-) ICP-MS, and Nd and Hf isotopes (the latter will be developed at ITES during the Ph.D. thesis).
ii) Determine how and when magmas are channelized to reach the seafloor and reveal the relation between magma emplacement, mantle exhumation by using field and geophysical approaches at fossil and present-day OCTs in the Alps and offshore Iberia (area of IODP proposal 943).
ii) Define the parameters and conceptual understanding of magmatic systems necessary to build innovative numerical/dynamic models of lithospheric breakup (in collaboration with Stefan Schmalholz (University of Lausanne) and Thibaut Duretz (CNRS Rennes)).

The PhD project takes advantage of excellent international collaborations, access to a unique sample collection of mantle rocks from OCTs at ITES, and a long experience in supervising PhD students all of which are necessary to succeed in such an ambitious project that will increase the international scientific visibility of the ITES. A support of the analytical costs, travelling and participation to conferences, estimated to about 30k€, will be provided by the supervisors.