

The Andrew Whitham CASP Fieldwork Award - 2020-21 Winner

Applicant: Martins, Gabriela

Project title: Structural characterisation and economic importance of salt welds: their field expression in the Moroccan Atlas Mountains

Scientific question and rationale: Salt flow results in areas of thickened and thinned salt, and causes the formation of salt structures. One such structure is a salt weld; this is a surface that marks the contact between rocks that were originally separated by a salt body, and which are now in direct contact as a result of the complete (or nearly complete) evacuation of salt due to solid-state flow and/or dissolution. By understanding the timing of a salt weld formation, it is possible to determine the original thickness of the source salt layer, which is important when attempting to reconstruct the geological evolution of salt-bearing sedimentary basins. Once welding occurs, it can also influence the future evolution of the basin, as the salt-tectonic system may no longer be able to translate horizontally as part of a gravity-driven, thin-skinned system. Salt welds have historically been thought to play an important role in petroleum exploration; i.e. in some settings hydrocarbons can be trapped below them, whereas in others fluids may be able to migrate across them to charge traps in other parts of the basin. More recently, however, it has become clear that understanding weld-related deformation is important to assess the capacity of these features to control the flow of hazardous nuclear waste, which is locally stored in related diapirs. Welds may also play a role in the ability of salt-tectonic systems to act as CO₂ repositories. Given the importance of salt welds my research aims to answer three questions: (1) How does salt thickness and composition vary within welds, and how does this relate to bulk thickness and composition of the original source layer? (2) Which factors control the capacity of salt welds to transmit or seal fluids? (3) How does the process of salt welding influence the seismic velocity, density and porosity of adjacent rocks and, how might it impact seismic imaging, reservoir quality, and trap definition? To answer these questions, I have already analysed subsurface data from the North Sea, an area being considered for salt-related CO₂ storage. The field portion of my project will be conducted in the Moroccan Atlas Mountains, where numerous salt welds are well-exposed. I aim to conduct fieldwork in partnership with a group of researchers from the Universitat Autònoma de Barcelona, led by Dr. Antonio Teixell; he is coordinating a project funded by the Spanish government to study salt tectonics in the Central High Atlas. Due to their project, it may be possible to share some expenses (e.g. accommodation, car hire), making it possible to do fieldwork at a relatively low cost.

Specific objectives and deliverables:

I will conduct detailed structural mapping of salt welds and their surrounding rocks during a 3-week field campaign (spring 2021). I will document salt weld lithology in different structural configurations (primary and secondary welds), deformation patterns and intensity (e.g. fractures), and evidence (e.g. cements) for how this deformation has controlled fluid flow.

Proposed work plan:

The first part of the field campaign will comprise large-scale, satellite image-based mapping of key salt-related structures (e.g. diapirs, minibasins, welds) with partner researchers from Barcelona. Having identified key field sites, I will conduct detailed mapping of salt welds (e.g. structural mapping, collection of strike and dip data, cross-section construction, fracture size/density mapping adjacent to salt welds in different structural positions such as primary and secondary welds). The resulting geological maps and structural data obtained from the fieldwork will be interpreted and integrated with satellite images.

Proposed expenditure, including details of any other sources of funding:

Flight tickets for 2 people from London to Marrakech (applicant and field assistant): £384

Car hire (4x4) for 3 weeks: £425

Fuel (travel to/from Marrakech) + (in/around study area with an average of 50 miles a day): £119.72

Accommodation (package including meals for 2 people x 21 nights): (21 x £50) £1,050

Total: £ 1,978.72