

Effect of Igneous intrusions on the Petroleum system

Fieldtrip to Orkney-

Marcus Duffy, University of Aberdeen.

Introduction:

In September 2017 myself, Dr David Healy and Dr Roberto Rizzo from Aberdeen University set sail for Orkney. David and Roberto focussed on the structural emplacement of igneous dykes whilst my focus was on the thermal impacts that intrusions have on different lithologies. I would like to thank the Mineralogical Society for a travel bursary which allowed me to participate in this fieldwork and collect samples for my PhD.



Figure 1. In the field with a new assistant to carry the heavy rocks!

Objective:

The aim of this fieldwork was to more quantitatively understand the effect of igneous intrusions on the petroleum system. The beach section at Birsay provided great exposure along a 400m transect of two dolerite dykes of Permian age that intrude cyclical sandstone, siltstone and shale beds of the Orcadian basin. The geology here was of interest due to the possibility of sampling multiple aspects of the 'petroleum system' in one place. With shales representing a potential source rock, sandstones possible reservoir rock and sandstone between en echelon steps in the intrusions representing potential migration pathways.

What I did:

Collected suitable samples of sandstone and shale to understand the thermal impact and subsequent petrophysical and geochemical changes with distance away from these igneous intrusions. The dykes were camptonites with phenocrysts of olivine, augite and hornblende in a groundmass of augite, hornblende and plagioclase. The host rocks are lacustrine deposits of the Lower Stromness Flags (Middle Devonian), and dip 20 degrees to the WNW. As well as sampling, a drone was used to image the area, sediment logs taken and Gamma ray recorded through the area of interest.

Follow up analyses:

I am currently in the process of creating core plugs for porosity and permeability measurements to assess the effect of reservoir quality away from intrusions. Optical mineralogy and SEM (scanning electron microscope) will also be used to study mineralogical change due to hydrothermal mineralisation. Shale samples will be crushed and prepared for TOC, Raman and GC-MS analysis, to observe maturity changes and temperatures experienced with distance from an intrusion.

What comes next?

This analysis will help in understanding the potential for intrusions and associated hydrothermal activity to effect reservoir properties and generation potential of source rocks



Figure 2 En echelon steps of dyke- possible migration pathways?

which will benefit exploration in volcanic regions such as West of Shetland.