

Deep Earth from Surface: lessons from Northern Ireland geology

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What can surface geology tell us about deep Earth processes and history? The answer of course is a great deal, but it isn't always easy to see through pervasive geological complexity to find solutions. This presentation provides examples, mostly from Northern Ireland, of long-lived faults and multi-use magmatic conduits both of which are fundamental to mineralisation. The geology of Northern Ireland is remarkably diverse and includes rocks of Neoproterozoic through to Palaeogene age. The region is located on a continental margin that has seen the opening of oceans and multiple, closure-related, orogenic events.

When it comes to magmatism Northern Ireland is well endowed, there are igneous rocks that were formed during opening of the Iapetus Ocean, and at various stages of its closure. Subsequent opening of the North Atlantic Ocean has also led to the development of large volumes of Palaeogene igneous rock, which form part of the North Atlantic Large Igneous Province (NAIP). The spatial coincidence of plutons formed at very different times and settings, points towards a shared route of ascent. For example we see plutons of Late Caledonian orogenic age (Early Devonian) intruded by NAIP igneous complexes.

Structures that channel fluids within the Earth are most often faults which once formed do not disappear. It is worth reiterating "once a fault always a fault," so that when the stress regime is favourably orientated they will reactivate. There are many examples of reactivated faults in Northern Ireland, the oldest are roughly N-S and E-W orientated and may have formed pre-Neoproterozoic times. There is evidence for reactivation of these faults at various times including all the recognised orogenic and ocean opening events.

In Northern Ireland there are examples of coincidence and over-printing of mineralization. Within the County Tyrone Cavanacaw gold deposit, which was formed primarily during the Grampian orogenic event (Middle Ordovician), there is evidence for Late Caledonian (Early Devonian) and possible Variscan (Upper Carboniferous) over-printing. Below the Cavanacaw deposit there is pre-Grampian (Lower-Middle Ordovician) arc/ophiolite related and Late Caledonian mineralisation.

So, is all of this just coincidental, or are there long-lived structures that act to channel mineralising fluids at various times when the tectonic regime is favourably orientated? The key to finding resources is to understand geological history and relationships at international-national and regional scales, so that long-lived, reactivated, multi-use structures and processes can be seen and appreciated.