

Deep continental subduction, Feb 2020, Anna Bidgood, Oxford University

Anna's research area had been in the Indian Himalayas where she had done 4 months field work, with shorter field trips in N E Greenland and Norway, and a conference in northern Russia. The India-Asia collision began about 50Ma ago although geophysicists were initially sceptical that a continental plate could be subducted beneath another one (unlike subduction of a heavier oceanic plate under a continent). However, it is now accepted that the Himalayan continental rocks provide clear evidence of very high T & P, principally from eclogites (garnet + omphacite pyroxene).

Eclogite was first identified in 1921 and because of the coarsely crystalline texture, it was thought to be igneous; only in 1965 were they recognised as connected with plate tectonics. Most commonly they are HP metabasalts from the descending oceanic plate; although rare in continental collisions, eclogites are found as metre scale pods in mudstone or granitic rocks, which themselves show no obvious evidence of HP minerals i.e. an intimate association of rock types which appear to have had very different geological histories. Previous explanations for this combination included 1) tectonic mixing, 2) both rock types had suffered very HP&T but with subsequent overprinting of newer minerals, and 3) they had both been subducted but the felsic rocks had not generated any new minerals.

Her work focussed on the mineral coesite - a HP form of quartz for which experimental evidence shows that it requires a depth of at least 100km to form. Note that the quartz-coesite transition is related purely to pressure and is not dependent on the presence of water as a 'catalyst'. There is even evidence from N E China of stishovite in continental rocks, an even higher pressure polymorph of quartz, requiring at least 350km depth, which can occur at meteorite impact sites.

The evidence from India is that the rocks now exposed have been down to at least 100km and brought back to the surface, with very little apparent change to the felsic rocks, and where coesite should no longer be stable. The key to this conundrum is that it can be inferred to have existed within very small grains within garnets, where there is a very distinctive texture indicating that quartz re-nucleated from coesite at the interface inside the garnet, in an elongate or columnar form which is called a palisades texture. This texture has also been recognised in both the Alps and Norway typically with a 20-micron rim around the normal textured quartz inclusion, but it is subtle and hard to

find. In the Himalaya, the palisades texture has been found at a much larger scale (cm) in a (low strain) granite, showing that all of the quartz transformed to coesite and back; the particularly HP demonstrated here may be due to the relatively thin Indian crustal slab and its high impact rate with Asia.

John Bennett