THE BASS CANYON SYSTEM
Talk by Jeremy Mitchell of Melbourne University on Wed 28 June 2006

The Bass Canyon System is a major present-day submarine feature located on the edge of the continental shelf off the Gippsland coast. There are five major shelf-breaching tributary canyons and several slope-confined tributary canyons which coalesce on the lower slopes to enter the massive deep-water Bass Canyon at a depth of 3500 metres. As such, this is one of the largest submarine canyon systems in the world. Its study is important for a number of reasons: as a major conduit for sediment into the ocean basin, in terms of marine biology and, of course, it is of great interest to the oil industry. Our speaker covered the present-day features and processes before talking about the geological history of the system

Jeremy first gave a couple of examples of the influence buried canyon structures have on the search for oil and gas. A fan of sand debouching from a canyon and then being covered in mud can one day become a litho-stratigraphic trap or reservoir sand for hydrocarbons so geologists search for similar structures in the strata. However, such structures buried to a depth of 1200m can also confuse the search for oil in that seismic waves travel faster through many canyon-fill sands as they are more prone to post-burial cementation. This has a 'pull-up' effect on the seismic section beneath the canyon-fill sediments giving rise to phantom anticlines. When drilling a hole costs $10-20 million, it can be an expensive mistake.

High-resolution bathymetry data and sediment sampling give a picture of the present underwater geography and processes going on. Canyons develop from the ridge and channel pattern on the middle slopes. When one of these channels eats back into the edge of the shelf (which is at a depth of about 130m) it taps into coarse calcium carbonate sand composed of broken remains of molluscs, bryozoans, forams and echinoids. This sand forms erosive gravity flows that scour deep V-shaped canyon profiles with side-wall slopes of up to 35 degrees. Once slope stability is reached at the canyon head, the profile degrades to a non-active U-shaped cross-section with side slopes of 10 degrees or less. These canyons are spaced roughly 11 km apart at their heads and feed into the huge deep-water Bass Canyon which extends 80km in length and is about 10km wide and has a box-shaped bottom profile. The deep-water Bass Canyon is likely to have ancient structural origins and probably sits in a depression formed during rifting and thermal subsidence associated with the break-up of Gondwana during the latest Jurassic (~150Ma) through to the Upper cretaceous (~90ma).

The method of submarine sediment flow varies with the nature of the sediment and the angle of slope, and the degree of sorting is variable. The sediment is almost entirely calcium carbonate in composition and can be as coarse as gravel where active erosion is occurring at the canyon heads but there is also mud composed of biogenic ooze, faecal pellets and terrigenous clay and silt. The type of movement ranges from slow creep to turbidity flows. A typical flow might start as a mix of pelagic mud and shelf sand on the upper slope, lubricated by its mud content but by the time it reaches the lower slopes it is mud-free. Elevated sedimentation rates and erosion are likely to be caused by intensification of the eastward-flowing seasonal current – the Bass Cascade. Similarly, the Spencer Gulf current may contribute to the formation of the Murray Canyons.

The present canyon system developed in the Late Pliocene (about 2 million years ago) at a time of high eustatic sea level (highstand) when sediment production was high. This is the opposite of the old view that these canyons were made by rivers flowing across the exposed continental shelf during glacial lowstands. However, coring of the last 250,000 years of sediment reveals two magnetic highs at 245ka and 135ka which were low sea level periods when rivers meandering across the continental shelf would have picked up more iron. Examination of BHP and Esso drill cores into the older sediments of the 2.5km-thick Seaspray Group (Early Oligocene – Pliocene) shows evidence of canyon infill going back much further. As depth of burial increases, so does compaction and crystallisation of calcite in pore spaces, which is of interest to oil companies in terms of reservoir capability and producing seismic images of underlying stratigraphy.

Our thanks to Jeremy for an excellent presentation with fascinating visual data and maps. Having been taken down to 3500m in Bass Strait we can honestly say that the Geology Group has plumbed new depths in the geological world.

Rob Hamson