DEFORMATION OF THE FLORENCE RISE, EASTERN MEDITERRANEAN, FROM EM12D SWATH MAPPING DATA

J.M. Woodside [1*], J. Mascle [2]
and shipboard scientists from the PRISMED II Expedition

[1] Centre for Marine Earth Sciences, Free University, De Boelelaan 1085, 1081 HV Amsterdam, The Netherlands
[2] Observatoire Oceanologique de Villefranche - UMR 6526, Geosciences Azur, B.P. 48, 06235 Villefranche-sur-mer Cedex, France

Key-words : Tectonics, swath mapping, Mediterranean Ridge

The Florence Rise was mapped in detail with Simrad EM12D swath mapping and a suite of geophysical methods (high speed seismic reflection profiling, 3.5 kHz echo sounding, gravity and magnetic measurements) during the French PRISMED II Expedition in February 1998. These data have been merged with similar data over the Anaximander Mountains, the northwesterly continuation of the Florence Rise structural trend, from the Dutch ANAXIPROBE expedition in 1995.

The Florence Rise is a gentle seafloor rise extending west from Cyprus to the Anaximander Mountains. It is an arcuate section of the Cyprus arc which runs from northern Syria through Cyprus to the Lycian promontory of southwestern Turkey. Because the Cyprus Arc has been considered to be a zone of late stage subduction of the thinned northern margin of northern Africa, the Florence Rise was thought to play the role of accretionary prism. The problem was that there is relatively low seismicity, no volcanism, no trench, and not much typical accretionary prism relief along the Florence Rise. The Antalya Basin to the north of the rise is a northward deepening and tilting sedimentary basin which existed already in late Miocene and therefore collected Messinian evaporites including massive halite. The Florence Rise, according to DSDP drilling results and other previous studies has only very thin evaporites (mainly gypsum) and thus was already a positive bathymetric feature in the late Miocene.

The swath mapping imagery from the Florence Rise region displays even subtle seafloor lineations and other evidence of neotectonic deformation, and the bathymetry shows the seafloor in unprecedented detail. The principal lineations do not provide an arcuate definition of the Florence Rise as might be expected; rather, there are cross- cutting features which are inferred to be strike-slip fault traces, with a general trend of about 065° to 075°. These cut obliquely across the roughly 116° trend of the rise in the area surveyed. The same east-northeast trends are most strikingly developed in the vicinity of the Eratosthenes Seamount to the south of Cyprus where they are also inferred to be faults.

Taking the Florence Rise and the eastern Anaximander Mountains to be tectonically and possibly structurally related, the entire arc from Cyprus to Turkey appears to be made up of about 5 or so more or less straight segments with slightly different trends and separated by faults or zones of discontinuity. Immediately west of Cyprus, the trends of the feature are roughly east-west despite two or three east-northeast to west-southwest oblique cross-cutting faults. West of about 32°E the trend shifts to about 116°, then west from near 31°E to about 145°, changing to 155° and then 165° in the Anaximander Mountains where the cross-cutting faults break the continuity of the structure.

If, as seems sensible to assume, the Florence Rise was formed originally as a result of subduction, then this has probably stopped or slowed substantially, and the tectonic situation altered. This may be a result of difficulties with the subduction of Eratosthenes Seamount under Cyprus. In any case, the Florence Rise is undergoing segmentation by the system of east-northeast to west-southwest faults, and the different segments are probably behaving independently. This is most evident where the eastern Anaximander Mountains segment is moving east-northeastward against the sediments of the Antalya Basin which have formed an arcuate fold belt as a result. The intensity of the compressional deformation here is probably responsible for the elevation of the eastern Anaximander Mountains which lie perpendicular to the inferred direction of compression. Closer to Cyprus the compression is more oblique and therefore causes less spectacular deformation, although this segment of the Florence Rise contains the uplifted block which was drilled during DSDP Leg 13.

One of the cross-cutting faults in the eastern Anaximander Mountains has caused a sinistral offset in the relief of the mountains, and gas vents and mud volcanoes are found along it. The mud and gas eruptions are believed to result from the release of pressure by penetration of the faults to a zone of overpressure (possibly a result of overthrusting) beneath or within the mountains. Analysis of the rocks brought up in the eruptions indicates that they are part of the Antalya Nappes Complex of southwestern Turkey. This suggests in turn that the deformation and relief of the eastern Anaximander Mountains is in part a result of fundamental geological differences with the eastern part of the Florence Rise. The swath mapping also suggests the presence of mud volcanoes on and just to the south of the eastern branch of the Florence Rise (high backscatter spots of circular positive relief), possibly also associated with faulting.

In summary, preliminary analysis of the swath mapping data in the few months since the PRISMED II campaign, along with the adjacent ANAXIPROBE data, suggests that the Florence Rise and eastern Anaximander Mountains are not part of a subduction system but form a zone of deformation related to the westward movement (escape) of the Anatolian plate and relative east-northeast to west-southwest convergence between the Anatolian plate and the African plate. The relative pole of rotation for this convergence is not likely to be too far to the south, which implies that the associated deformation is relatively slow.