

Conference Report

Tethyan Working Group

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Report of a meeting of the Tethyan Working Group, held at the University of Edinburgh, on 26–27 April 1989. The conveners were P. D. Clift, G. Jones, J. E. Dixon and A. H. F. Robertson.

This was the latest in a long established series of Tethyan Working Group meetings, the purpose of which is to provide a forum for the presentation of recent research work on the Tethyan realm. It has become apparent that only by the use of an integrated variety of geological techniques, can major advances be made in our understanding of this complex orogenic belt. The meeting reflected this approach by tackling various aspects of Tethyan tectonostratigraphic development. The Working Group was attended by about 40 geologists and geophysicists, with several from collaborating continental European laboratories.

The first talk on the Greek area was given by **A. H. F. Robertson** (Edinburgh University), who documented a two stage ophiolite emplacement history on the island of Evvia, which occupies a critical tectonic position in central E. Greece. Using a multidisciplinary approach he discussed the probable root zone of a Jurassic, supra-subduction zone ophiolite and presented new evidence for the formation of late Cretaceous oceanic crust in the area. **P. D. Clift** (Edinburgh University) continued this theme, with a description of the various tectonic units within the Argolis area of southern Greece. In the light of field geological and palaeomagnetic work he demonstrated a two stage ocean basin closure history in this area and summarized evidence of spreading in a late Cretaceous, Neotethyan ocean basin. **S. K. Matthai** (University of Tübingen, FDR), in a joint paper with **W. Frisch**, went on to present detailed structural and palaeontological evidence for the timing and direction of ophiolite emplacement within the Argolis Peninsula, that is from the present NE to SW. Possible evidence for an early Tertiary ophiolite emplacement event was discussed, although this hypothesis conflicted with earlier results presented by P. D. Clift.

In the northern Greek area **G. Jones** (Edinburgh University) presented a comprehensive model for the evolution of the Subpelagonian and Pindos Zones throughout Mesozoic and Tertiary time. A two-stage emplacement history for the Pindos ophiolite and associated thrust units was presented based on geochemical, structural and sedimentological data. **A. Rassios** (I.G.M.E., Greece) continued the story of the Pindos ophiolite by considering part of the ultramafic mantle section present in the area. New detailed structural data from within the peridotite enable the recognition of discrete NE-verging, early shear

zones, which match previous fabrics occurring within the Vourinos ophiolite located east of the Mesohellenic molasse trough. A lively discussion session then covered the tectonic evolution of the Pindos Mountains and wider questions of the mobility of microplates within the western Tethys area.

In a session comparing Tethyan and modern day oceanic processes, **J. R. Cann** (University of Newcastle-upon-Tyne) discussed hydrothermal metamorphic processes within the Troodos and Pindos ophiolites. Using examples from each area, he reviewed the processes observed at modern spreading centres and how they could relate to Tethyan Mesozoic ophiolites. The occurrence, petrology and geochemistry of the magmatism above subduction zone was discussed by **D. Kostopoulos** (University of Newcastle-upon-Tyne). He concluded from available geochemical and experimental data that boninites must be produced by wet melting of a depleted, residual mantle source at shallow depths. In his view this could only arise if both the hanging- and foot-wall plates in a subduction setting were young and hot, thus imposing specific constraints on boninite settings. A joint presentation by **G. Nichols & R. Hall** (University College, London) expanded on the nature of Tertiary and present-day plate tectonic processes in the SW Pacific, Halmahera area, in relation to Tethyan analogues. In particular they emphasized the relatively short time spans required for major oceanic processes to occur, (e.g. formation of major volcanic arcs) compared to the long time intervals available in the Tethyan area. In the ensuing discussion, the apparent lack of true volcanic arcs associated with the western Tethyan ophiolites was noted, by contrast to the SW Pacific.

Broadening the scope of the discussion into Asia, **M. B. Allen** (Leicester University), in a joint paper with **B. F. Windley**, proceeded to discuss the reactivation of a Palaeozoic orogenic belt in the Tien Shan during the Tertiary collision of India with Asia. This was compared to earlier Mesozoic, Palaeo-Tethyan collisions which had produced no apparent effect on the orogen and adjacent basin. **C. A. Boulter** (Nottingham University), in conjunction with **D. A. V. Stow, C. Chen, Y. Du, B. Ke & S. Wang**, continued the Asian theme, discussing preliminary work in the Yunnan region of S China. He applied the terrane hypothesis to the identification of a series of ocean-continent suture zones southwest of the Yangtze Block, and considered possible complications resulting from collision in the Himalayan region.

The second day commenced with a return to the Greek theme, when **D. J. W. Piper** (Geological Survey of Canada), jointly with **G. H. Pe-Piper**, reviewed the occurrence and chemical characteristics of igneous rocks

associated with the Pindos thrust sheets of the Peloponnese. The palaeocurrents and the significance of the Mesozoic deep-water sedimentary units of the area were also discussed. Continuing the Pindos story, **A. Kantza** (University of Newcastle-upon-Tyne), in a joint paper with **J. R. Cann**, summarized work carried out on the hydrothermally altered sections of the Pindos ophiolite in N Greece and went on to develop a model utilizing immobile trace element geochemical data to calculate elemental fluxes during hydrothermal metamorphic processes, and to show that trace-element ratios characteristic of different lava types were preserved even in extensively altered rocks.

Moving westward to the external foreland of the Hellenides, **J. R. Underhill** (Shell U.K./Edinburgh University) discussed the interplay of Alpine thrust tectonics and deformation related to initiation of subduction along the Hellenic trench system. Examples were given from the Pre-Apulian sedimentary sequences of Kephallonia and Zakynthos in W Greece, showing that young convergent tectonic deformation is widespread in the so-called autochthonous foreland region. Dealing with the internal Serbo-Macedonian Zone, **J. E. Dixon** (Edinburgh University) demonstrated the autochthonous nature of the deformed and metamorphosed Volvi ophiolite complex in NE Greece. Geochemical evidence suggests that Volvi, and some related ophiolite complexes, may have inherited supra-subduction zone geochemical signatures from previous tectonic settings. Moving much further east **G. Kelling** (University of Keele), in a joint paper with **S. L. Gokcen**, **N. S. Gokcen**, **E. Gokten** & **A. J. Bromley**, discussed the sedimentological development of the Sivas-Refahiye basin, in central Anatolia, Turkey from late Cretaceous to Pliocene time. The speaker related facies changes to periods of tectonic instability within the basin and distinguished four cycles of sedimentation, related to final suturing of the Neo-Tethys in this region.

K. M. Creer (Edinburgh University) considered the application of palaeomagnetism to the Tethyan belts by reviewing the rotational history of the Italian area and pointing to the mismatch with the data for Africa, demonstrating the independent motion of the Adriatic promontory. **W. Birch** (Liverpool University) presented a palaeomagnetic study of the western and central Greek areas, suggesting that this region had suffered a two-stage clockwise rotation totalling 50 degrees, during the Neogene. This was a result of a complex interaction of microplates in the East Mediterranean and the changing geometry of the Hellenic arc through time. The results of palaeomagnetic studies on the Troodos ophiolite were presented by **A. Morris** (Edinburgh University) in a joint paper with **K. M. Creer** & **A. H. F. Robertson**. He demonstrated that about 40 degrees of anticlockwise rotation of the Cyprus

microplate took place over 15 Ma, between the Turonian deposition of umbers and the end of Campanian radiolarite deposition. Additionally it was shown that lava blocks associated with the Arakapas transform fault have undergone 70 degrees of clockwise rotation relative to the average Troodos vector. This was interpreted as being the result of rotation of small-scale blocks within the field of an oceanic fracture zone.

G. J. H. McCall (Liverpool University), in a joint paper with **B. R. Rosen**, discussed the stratigraphy and palaeontology of Miocene patch reefs within the Makran Mountains of Iran. A diverse fauna of corals and associated reefal organisms was reported, including numerous previously unrecorded species. A palaeo-environmental interpretation of these reefs within a dominantly clastic succession was presented. This theme was continued by **E. J. Follows** (Edinburgh University) who demonstrated the development of Miocene reefs on the uplifting margins of the Troodos ophiolite in Cyprus. Using examples from several areas, he showed how structural controls governed the faunal diversity, framework style and diagenetic history. During the Messinian, gypsum was deposited in small fault-controlled basins and the whole sequence was subsequently transgressed, undisturbed, by the Pliocene sea. The Quaternary history of the Troodos Massif was considered by **A. J. Poole** (Edinburgh University), who described marine terraces related to the uplift of Cyprus during this time. The uplift has caused the deposition of voluminous sediments of diverse facies, ranging from alluvial fan to beach and aeolian deposits. The author went on to consider the effects of sea-level and climatic change and how this relates to the rapid tectonic uplift.

The final talk was presented by **I. S. Stewart** (Bristol University), in a joint paper with **P. L. Hancock**, who considered the morphologies of Neotectonic fault scarps within the Aegean region. Three main types were identified and characterized according to their particular fault plane geometries. The relative timing of fault scarp features, such as brecciation, was detailed.

In addition to the scheduled programme a number of participants also attended the annual Britoil Celebrity Lecture, which was given this year by **J. A. Jackson** (Cambridge University) on the processes of block faulting and the continuity of deformation on the continents.

Overall, the Working Group demonstrated how groups of specialists, working on different topics and based in different university departments can come together to exchange information and collaborate effectively. It is hoped to hold the Tethyan Working Group next year at University College, London. New participants are very welcome and are invited to register their intent with us, or with Dr Robert Hall at University College.