Ordovician of Iberia – Report on the 11th International Symposium on the Ordovician System

9-13 May 2011, Madrid, Spain

The Iberian Peninsula is well known for its extensive outcrops of early Palaeozoic rocks and its high palaeo-latitude position during the Ordovician on the southern polar margin of Gondwana, had profound effects on the faunas and facies of the time. It was therefore timely that more than 120 participants from 26 countries took part in the programme consisting of three days of lectures, a mid-symposium and pre- and post-symposium field trips, described herein.

All participants arrived to find the published proceedings in the form of a handsome book, *Ordovician of the World*, of 679 pages, now available to be downloaded, (<http://www.igme.es/isos11/volume.htm>), free of charge, as a pdf. The meeting had several sponsors, including the Subcommission on Ordovician Stratigraphy of the International Union of Geological Sciences.

The 11th International Symposium on the Ordovician System (ISOS), held from May 9-13, 2011, was the most recent of a series of highly successful meetings hosted by the Madrid-based team of Juan Carlos Gutiérrez-Marco, his wife Isabel Rábano and Diego C. García-Bellido and ably assisted by colleagues from institutions elsewhere in Spain and Portugal.

The venue was Alcalá de Henares, a delightful university town, listed as a UNESCO World Heritage Site and situated 40 minutes by train from Madrid. For many visitors, Alcalá was a most pleasant surprise: the birth place of Cervantes and Catherine of Aragon, the covered shopping precinct with ornate embossed gargoyles and the various spires and turrets with nesting storks. Accommodation was open; many chose local apartments and guesthouses in the town while others preferred the cloistered hall of the old University in an adjoining courtyard to where the meetings were held.

More than 120 participants from 26 countries took part in the programme consisting of three days of lectures, a mid-symposium and pre- and post symposium field trips. All activities – including the wine receptions, tea, conference dinner and a guided tour of the historic quarter of Alcalá – were heavily subsidised by a total of 15

institutions and 8 corporate bodies. Obtaining such sponsorship in challenging economic times was a tremendous feat of the organisers and something for which all participants were surely grateful.

The smart conference rucksack contained a number of goodies not the least of which was the weighty 679 page book “*Ordovician of the World*” (Publicaciones del Instituto Geológico y Minero de España Serie: Cuadernos del Museo Geominero, No 14. ISBN 978-84-7840-857-3) edited by Juan Carlos Gutiérrez-Marco, Isabel Rábano & Diego García-Bellido. This contains extended abstracts and short papers of all the lectures and posters presented, and to have it at the start of the meeting is an exceptional triumph for the editors and a great companion for the participants. This publication can be downloaded (<http://www.igme.es/isos11/volume.htm>) as a pdf and free of charge.

There were two brilliant keynote lectures each abounding in fascinating detail with unbelievable pictures. Jean-Francoise Ghienne (France) reviewed the Late Ordovician Glacial Record, convincingly demon-

strating that the end Ordovician ice-sheet may well have been the largest known from the Phanerozoic, extending as it did from Arabia to North and West Africa and into South America and South Africa. Peter Van Roy (Belgium) documented two exceptionally preserved soft-bodied Ordovician biotas from Morocco showing that analogues of the earlier Ediacaran and Burgess Shale taphonomic windows are still open in the Ordovician.

Nine symposium sessions explored current research in Ordovician climate, chronostratigraphy, biostratigraphy, faunal changes, biodiversity, unique faunas, structural geology, geochemistry and sedimentology. The following short choice of highlights is bound to be biased and subjective but each lecture provided a “state of the art”, from young workers now forming the new generation of Ordovician aficionados and those who have been with ISOS since the start. Every Subcommission chairman through time has overseen a new research emphasis and David Harper (Denmark) is no exception. His contribution to the understanding of the Great Ordovician

Group photograph of the Alcalá Symposium delegates outside the main door of the old University (May 2011). (Photo: The organisers).

Biodiversification Event was mentioned in his opening speech which reviewed six decades of attaining a precise global chronological framework. He and co-workers followed this up with results from work in the Himalayas, confirming that the top of Mt. Everest really is Ordovician!

Ordovician $\delta^{13}\text{C}$ isotope excursions curves featured in the presentations of several authors. Thomas Servais (France) on behalf of his co-workers, showed instructively how immediately prior to the Hirnantian excursion acritarchs show a remarkable increase in abnormal, teratological growth forms at the same time as extinction among others groups of marine organisms (conodonts, graptolites and trilobites) occurs. Obviously environmental changes are the likely cause but what they were and what triggers them is still under debate.

It took more than 12 years to reach a decision on where to draw the Cambrian/Ordovician boundary and now Fredrik Terfelt (Sweden) and colleagues have suddenly let the cat out among the pigeons by showing the diagnostic conodont, *Iapetognathus fluctivagus*, to be absent from the stratotype section at Green Point, Newfoundland, and thereby calling into question the biostratigraphic requirements of this GSSP. How could this have happened and what were the conodont experts doing when the choice of Green Point was made? We must wait and see what the ensuing debate brings forth. Roger Cooper (New Zealand) provided a most stimulating lecture in which he and co-author (Pete Sadler; England) reported on their studies of evolutionary rates in graptoloids, showing that the patterns in the Ordovician are in marked contrast to those in the Silurian and these are related to changes in ocean chemistry, circulation and climate patterns from the end of the Ordovician and into the Silurian.

At ISOS VI held in Norway in 1982, the late Valdar Janusson (Sweden) presented a seminal lecture on what makes the Ordovician so special. All lectures in Alcalá provided a deep insight into just this – a time of extensive seas and limited continents. Magmatic and tectonic activity accompanied rapid plate movement and oceans contained emergent island arcs. Carbonate sediments were dominant in the shallow epicontinental seas and shelly organisms abounded along with the pelagic graptolites and nektobenthonic conodonts. Biogeographical differentiation was widespread, but since 1982 the difficulties faced by global correlations due

to faunal provincialism have now become less of a problem as carbon isotope studies increase, local faunas are revised and new data sets are tested and analysed. An emphasis on marine geochemistry was obvious in many lectures and environmental changes in the Ordovician plankton world are areas which we shall be hearing more about in the future. It was consoling to see that each contribution contained reference to the three international series and seven stages on which the Ordovician System is now defined. This is a great tribute to the tiring work of the International Subcommission on Ordovician Stratigraphy.

Following the lecture sessions the two day Symposium field trip (May 12-13) to the Province of Ciudad Real was a great social gathering in which participants were able to collect abundant fossils from the Middle Ordovician (Oretanian) Navas de Estena Shales at the Cuesta de Valderuelo Section (day 1) and the Guindo Formation at the Fresneda Dam Section (day 2). A pleasant walk along the Estena River section of the Cabaneros National Park (day 1) ended at the surprise locality and stop for a group photograph in front of the giant, looped trace fossil and chosen symbol of the meeting. Measuring some metres in length, this lined burrow is thought to have been made by worms? Some worms!

Accommodation at the end of day 1 for some was in elegant rooms within the outer walls of the bull-ring at Almadén. The bull-

ring (still functional) was built for entertainment of the workers at the famous Almadén mercury mines, visited the next day. This was a real highlight with a tour underground and walks along brick and wood supported galleries now part of the Almadén Mining Park, opened in 2006 five years after mining ceased. The host rock is Ordovician (Hirnantian) to lower Silurian quartzites in which the cinnabar and native mercury ore bodies occur. Throughout the 2,000 year history of the mine, more than 200,000 tons of mercury was extracted and used in the separation of gold from ores brought home from the Spanish colonies, mainly in South America. Not only was the tour underground fascinating but also the museum and displays above ground.

The social success of a field trip relies heavily on the humour and competence of the leaders and bus drivers, the weather and the accommodation. All was first class.

The 5-day pre-symposium field excursion focused on the Ordovician of Portugal, and provided the opportunity to view the results of recent stratigraphic and paleontologic studies. The excursion was led by Artur Sá, José Piçarra, Nuno Vaz, António Sequeira, and Juan Carlos Gutiérrez-Marco, who also authored an elaborate, finely illustrated guidebook "Ordovician of Portugal". Ordovician outcrops throughout the length of the Central Iberian zone of the Iberian Massif were visited in central and northern Portugal and in southeastern Galicia, Spain.

Group photograph in front of looped giant worm burrows in Lower Ordovician American Quartzite. Mid-symposium excursion, Estena River section. (Photo: Anne Bruton).

Tremadocian strata are poorly exposed and limited in extent in Portugal, yet the overlying American Quartzite of Floian Age outcrops widely and forms prominent topographic highs throughout Portugal. Darriwilian, Sandbian, and Katian strata are richly fossiliferous locally, and the Hirnantian is represented by diamictites. Outcrop areas visited in Portugal from south to north included the Amêndoa-Mação syncline, the Buçaco syncline, the Arouca Geopark, and the Valongo Anticline. The diverse trace fossil assemblage in the siliciclastic Santa Justa Formation and the giant trilobites of the Valongo Formation in the Arouca area are impressive, and the visit was memorable. The Sil River canyon in Galicia is the location of a Middle Ordovician to Silurian succession that is most notable for its thick Katian limestones, unusual for peri-Gondwana, that are contemporaneous with the Boda Event and a Homerian locality with abundant graptolite synrhabdosomes. Many special events, several hosted by local government officials, were organized by the field excursion leaders. They included a Brazilian asado in Amêndoa area, a night at the Buçaco Palace Hotel (the last hunting palace of the Portuguese Kings), an afternoon at the Geological Interpretation Center of Canelas (Arouca) to view its wonderful display of giant trilobites, an evening organ recital at the medieval Arouca Monastery, a walking tour of Porto City, including a port wine cellar, a visit to the Valongo Paleozoic Park and its small museum that includes a wonderful private collection of trilobites from the Valongo Formation, a delicious seafood lunch in Porto City, and “Las Médulas” Roman Gold mine in Galicia – a UNESCO world heritage site. The excursion provided a detailed exhibition of the complete Ordovician succession of the Central Iberian zone in Portugal and Galicia as well as its paleontological content. The participants were warmly welcomed by local government officials and enjoyed several social events, making for a valuable, memorable experience.

Thirty people followed up the meeting in Alcalá with a three day post-symposium field trip to the Iberian Range in NE Spain, ably led by Enrique Villas and Andrea Jiménez-Sánchez (University of Zaragoza), Javier Álvaro (Centre of Astobiology, Spain), Samuel Zamora (NHM, London) and Juan Carlos Gutiérrez-Marco (Madrid). The first stop visited, located in the Sierra Menera massif about 120 km SW of Zaragoza, was an abandoned open-cut iron ore quarry

Group photograph on pre-symposium excursion at the Las Médulas Roman gold mine in Galicia, Spain. An UNESCO World Heritage site. (Photo. S.C. Finney).

hosted in the Katian Ojos Negros Formation here consisting of dolo-stones and bryozoan-rich carbonates, overlain by Hirnantian Orea Formation glacio-marine shales. The latter unit, including diamictites, was particularly well-exposed in a long cutting along the Checa-Orea road, examined on stop 2. These terminal-Ordovician glacial deposits are overlain (with an erosional contact) by the Lower Silurian Los Puertos Formation. Although predominantly quartzitic elsewhere, the Los Puertos Formation exposed in this cutting contained graptolitic faunas of Rhuddanian to Telychian age in black shale. Abundant graptolites of Telychian age were also available to be collected on the final stop of the day at the Alto Tajo Natural Park, where a large dropstone in the Los Puertos Formation had been caged (thanks to intercession by Juan Carlos Gutiérrez-Marco), thereby saving it from marauding humans. Overnight accommodation was in the medieval fortified town of Albarracín, one of the cultural heritage gems of Spain dating back to the tenth century. The early evening downpour that coincided with our arrival fortunately cleared by the following morning, enabling enthu-

siastic photographers amongst the excursion participants to capture this magnificent setting as the sun crept over the surrounding Mesozoic limestone ridges, prior to resuming our geological investigations of the eastern Iberian Chain. At the Tor Rock section near the hamlet of Fombuena (where lunch was subsequently taken), Upper Ordovician rocks are represented by the Fombuena Formation and Cystoid Limestone, the latter particularly rich in bryozoan and echinoderms, associated with extensive mud mounds up to 2 m high and 6 m in diameter, flanked by off-mound calcarenites. Localities visited in the afternoon concentrated on further lateral facies of the Cystoid Limestone, finally encountering limestone dropstones in the

Active field work in Upper Ordovician Cystoid Limestone, Tor Rock. Post-symposium excursion. (Photo: I. G. Percival).

overlying Orea Shales of glaciogenic origin, interpreted as dispersed by drifting icebergs. Daroca, our destination for the second night of the excursion, was another walled town of considerable antiquity and distinctive architecture. The third and final day of the excursion visited outcrops of Lower Ordovician strata in the western Iberian Chain, where the stratotype section of the Valconchan, Dere and Santed Formations was examined. This was a very instructive sedimentological sequence comprised of

stacked shallowing-upwards parasequence sets, largely devoid of fossils except for rare horizons characterised by lingulide brachiopods. The well-exposed road section up to Santed Summit again proved the serendipitous nature of conference excursions, as Nicolay Sennikov (Novosibirsk) discovered graptoloids that provided the first-ever confirmation of the Early Ordovician (Tremadocian) age of these rocks. A traditional Spanish banquet concluded the post-symposium excursion,

which was notable for its excellent organisation, accommodation, food, and of course superb outcrops.

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