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Final Cambro-Ordovician Boundary Meeting, People's Republic of China

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F. Oldfield found that colour differences in the Strezlecki dune field, Australia, were independent from the magnetic signatures which depended on location within the field and position within the dune.

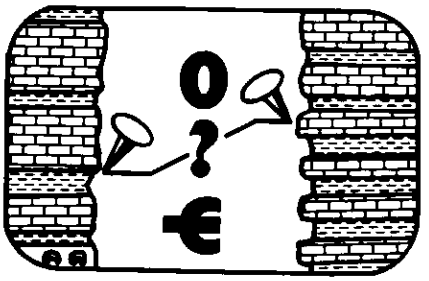
In one of longest complete cores from Australia, the 22 m Lake Terang core, Charlie Barton *et al.* determined that although the paleomagnetic Q-ratio (intensity/susceptibility) paralleled the organic content curve, the former did not agree with median destructive field data regarding the magnetic mineral type and stability. Neither the Mungo nor Laschamp paleomagnetic inclination excursions were seen, nor was there any correlation with other Australian sequences, and dates were reported only for the upper portion of the core. Hence, no sedimentation rate could be estimated, although the authors claimed this core represents about 100,000 years of sedimentation.

Two papers to be presented by Chinese scholars were unfortunately not given due to inadequate translation facilities, although the authors were available to answer questions arising from the abstracts. Since such problems often hamper international conferences, it behooves organizers to consult speakers in advance to further unbiased scientific discussion.

Although the scientific calibre of the meeting was generally high, poor communication skills overshadowed several presentations. When will our profession learn that the obvious importance of the work cannot carry the burden in lieu of a well-organized, audible, concise, coherent argument illustrated with neat, well-labelled, legible, colourful diagrams? In interdisciplinary meetings such as this, moreover, it is often necessary to downplay the technical language and simplify the applications of the more peripheral techniques in order to maximize their impact.

By the end of the conference, it was obvious that arid region paleoenvironmental studies are severely limited by a dearth of proven dating methods. With the exception of ^{14}C for fossils and charcoal and ^{36}Cl for water or NaCl, the latter method still in its infancy, no methods have yet successfully dated either the typical mineral deposits or the fossils. Consequently, it is difficult, if not impossible, to estimate sedimentation rates and to time environmental changes, particularly beyond the range of ^{14}C. If our knowledge of arid regions is to progress, it can be only hoped that the next few years will see the perfection and vindication of dating techniques for older fossils, pedogenic carbonates, and other minerals, and that methods can be developed that will span the ^{14}C—K/Ar gap.

Accepted 16 April 1987



Final Cambro-Ordovician Boundary Meeting, People's Republic of China

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The final meeting of the International Working Group on the Cambro-Ordovician Boundary (IUGS Commission on Stratigraphy) was held at Hunjiang (pop. about 150,000) in the Province of Jilin (once part of Manchuria), People's Republic of China in late July-early August, 1986. It came after some 12 years of formal and informal discussions and site visits by geologists interested in the Cambro-Ordovician boundary.

Some 24 foreign delegates from Australia, Belgium, Canada, France, Great Britain, Italy, Japan, North Korea, Norway, Sweden, United States, and West Germany met with 46 Chinese colleagues from local geological bodies and colleges and the Nanjing Institute of Geology and Paleontology. The section near the village of Dayangcha, 25 km from Hunjiang was chosen by Chinese geologists as their best candidate for consideration as the Cambro-Ordovician boundary stratotype. The meeting lasted five days with two days spent examining and collecting from the section and three days spent in the nearby city of Hunjiang where a number of formal presentations were made on the sedimentology and biostratigraphy of the Dayangcha section, on other potential boundary stratotypes around the world and on the biostratigraphy of various fossil groups. The last stage of the meeting consisted of open discussion and debate.

The strata crop out along a road and creek bank, and considerable work had been done by the villagers to expose and label the section, including diverting the creek. Several hundred metres of carbonate rocks are exposed and other sections in nearby quarries also contain boundary interval strata. The consensus of most workers was that the carbonate strata were deposited under deep shelf conditions, with just one horizon with stromatolites indicating a shallowing event. A good variety of fossils is present especially conodonts, trilobites, graptolites and acritarchs. Geologists with the Nanjing Institute of Geology and Paleontology had done a variety of detailed studies in the last few years and their results were presented at the meeting, orally and in book form.

Aspects of Cambrian-Ordovician Boundary in Dayangcha, China, a large book of 410 pages and 98 plates, was edited by the project leader Chen Jun-Yuan and copies can be obtained from him at the Nanjing Institute (price not known). The volume covers the lithostratigraphy, petrography, depositional environments, clay mineralogy, rare earth and other trace elements in apatite across the proposed boundary, Rb-Sr dating of the sediments, and biostratigraphy and taxonomy of the conodonts, graptolites, trilobites and acritarchs. It is a remarkable piece of work considering it was but a few years from start to finish for this entire research effort.

The criteria for a Cambro-Ordovician boundary stratotype were formalized as a number of non-binding resolutions at the 1985 meeting in Calgary. Conodonts are to be the primary guide fossils as many of their species are cosmopolitan and a number of new evolutionary forms, particularly species of *Cordylodus*, originated around the time under consideration. Their presence in a wide variety of lithologies and environments, and commonly in abundance, make them "ideal" index fossils. A second criterion was that the boundary is to be drawn at an horizon close to the appearance of the first nematophorous graptolites, which will be used as the field guide for the boundary. Although graptolites have been a traditional guide fossil for the base of the Ordovician, their rarity or absence in shallow platformal carbonates and their difficult taxonomy has prevented their use as the key index fossil group. Two candidate species of *Cordylodus (C. intermedius* and *C. lindstromi)* have been proposed for the boundary definition and the use of the first appearance of either will raise the boundary a little higher than an earlier candidate, *i.e.*, the first appearance of *Cordylodus proavus.* Stability is also promoted as the first appearance of one of the subspecies of the graptolite *Rhabdinopora flabelliformis* (formerly *Dictyonema flabelliforme)* was used in the past to identify the base of the Ordovician in graptolitic sequences. Unfortunately, trilobites have proven to be too endemic for use in global correlation.

A third criterion, and one agreed on for the first time in consideration of an international boundary stratotype, was that the section has potential for the use of paleomagmetism, geochemistry and other non-biological correlation tools. This resolution was prompted by the finding by J.L. Kirschvink and A. Kobayashi-Kirschvink (Cal Tech)(unpublished) of a magnetic polarity flip in latest Cambrian strata in the Maly-Karatau Range, Kazakhstan, USSR. This information awaits confirmation from

other sections. The magnetic signature is lost in strata which have been heated to temperatures of more than 100°C; hence, the need for a thermally immature sequence.

Work by J. Wright, W.T. Holser (U of Oregon) and J.F. Miller (SW Missouri State U)(paper in press) on chemostratigraphy of conodonts and inarticulate brachiopods across the boundary interval within the western US indicates that cerium anomalies can be correlated within the area. However, reconnaissance samples from Dadoushan, SE China, failed to show the same anomalies. Chen Jun-yuan and others (symposium volume) reported a cerium anomaly close to the proposed boundary at Dayangcha. Clearly much work is required if such anomalies are to be useful tools in correlation.

After site visits to places as diverse as the old stratotype in Wales, western Queensland, SE China, western US, Norway, Kazakhstan, Alberta and Newfoundland, the number of suitable sections was narrowed to two at a meeting of the Working Group in Calgary in 1985. The two sections are Broom Point North, western Newfoundland and Dayangcha.

The former is a section of the Cow Head Group exposed on the coast. It contains an alternating sequence of deep-water carbonate and clastic beds deposited on a continental slope. All three fossil groups useful for defining a boundary are present: conodonts, graptolites and trilobites. This section is being advocated chiefly by C.R. Barnes (Memorial University of Newfoundland) and much work has and is being done by a variety of faculty, researchers and graduate students from Memorial and elsewhere.

Both Broom Point and Dayangcha have much to offer, particularly a diversity of fossils and a low level of thermal maturation. There are some problems however with both sections. The base of the Ordovician at Dayngcha is proposed on the first appearance of *Cordylodus intermedius*; however, a 6 m thick siltstone unit (with rare carbonate beds) immediately underlies this level and poor recovery of conodonts has resulted. Further work on this interval, to improve the recovery of conodonts, is underway. The problems with the Broom Point North section revolve around a significant unconformity low in the interval under consideration, although C.R. Barnes is advocating the first appearance of *Cordylodus lindstromi* (which occurs some 5-6 m higher) as the base of the Ordovician. The conodont fauna have an abundance of *Cordylodus* species, a number of which are new and a detailed phylogeny has been determined (Bagnoli and Barnes, in press). It does have a poor representation in non-cordylodan species which are also useful for biostratigraphy.

Conodont biostratigraphy has reached a high level of refinement, particularly due to the work of J.F. Miller on sections in Utah, Oklahoma and Texas. The changes in the fauna within the boundary interval *(C. proavus* to *C. lindstromi)* are numerous and consistent enough that the first appearances of coniform-element taxa as well as species of *Cordylodus* can be used in correlation, and a preliminary graphic analysis (Shaw's method) of sections was presented by Miller at the Dayangcha meeting. These North American sections will remain the key reference sections for platform-facies conodont biostratigraphy for some time as it will be several years before the two candidate sections reach the same level of biostratigraphic refinement.

A vote for one of the two candidate sections will be asked of the voting members some time in 1987.

Brian S. Norford, Geological Survey of Canada, Calgary is the chairman of the Working Group and James F. Miller (SW Missouri State University, Springfield) is the secretary. Both have done a sterling job in these last few years as the pace of interest has quickened and the need for a decision has become more urgent.

Accepted 25 January 1987.

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