

New perspectives in Basin Analysis: A Symposium in honour of F.J. Pettijohn, University of Minnesota, Minneapolis.

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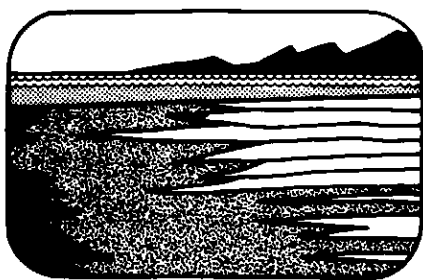
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New perspectives in Basin Analysis: A Symposium in honour of F.J. Pettijohn University of Minnesota, Minneapolis

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Francis J. Pettijohn is the acknowledged father of modern sedimentary geology. He is the author of several widely used textbooks and has made numerous contributions to original research. Pettijohn's main contributions have been to the study of sedimentary petrology and paleocurrent analysis. His classification of sandstones and his seminal paper on "Paleocurrents and Paleogeography" are classics. He is also well remembered for his contributions to the study of Precambrian sediments. His four major textbooks have each appeared in several editions and are still a standard part of the library of every sedimentary geologist. Many of us have enjoyed reading his memoirs ("Memoirs of an Unrepentant Field Geologist"), in which he makes an eloquent plea to keep geology firmly based on field work and not to get so caught up with computers and high-tech laboratories that we ignore the "ground truthing", as the remote sensors now like to call it.

Many students of Pettijohn have themselves gone on to become eminent geologists but, in a very real sense, we are all his students because of the enormous influence his books have had on successive generations of geologists. Pettijohn received his Bachelors, Masters and Doctorate degrees from the University of Minnesota, and taught there for several years before the war. It is fitting that his university recognize his achievements with the award of an Honorary Doctorate, and it was decided to make the award this spring. Chris Paola and Karen Kleinspehn, two faculty members on staff at U of Minnesota specializing in sedimentary geology, were the moving forces behind this award, and decided to organize a symposium

around the event to honour Pettijohn by showing how the subject he invented has evolved in recent years. The honorary degree was presented at a banquet, at which Ed Clifton provided us with amusing reminiscences and several classic Pettijohn stories. We could not help but feel as if we were participating in a little bit of geological history as we all rose in a standing ovation for this distinguished scientist.

This was the second such honorary occasion for Pettijohn. Many of us have learned much from the book *Evolving Concepts in Sedimentology* published in 1973 as the proceedings of a symposium held in honour of Pettijohn's retirement from Johns Hopkins University.

This symposium, held 8-9 May 1986, consisted of a mix of invited and volunteered contributions. For those of us who take a broad view of the subdiscipline of basin analysis, the symposium offered an unrivalled opportunity to review the entire subject. There were few pot-boilers — everyone seemed to be offering their best, and it was a very stimulating meeting. The conference was followed by a weekend field trip to some of Pettijohn's old field haunts in northern Minnesota, which this writer did not attend.

He should have been quite pleased by the general health of field work, as judged from the various research methodologies reported at this meeting. The turn away from field studies at some institutions in the forties and fifties, that Pettijohn lamented, has now clearly been balanced by the realization that real problems can only be solved by multidisciplinary studies, with full attention paid to careful field structural and stratigraphic mapping, and with the development of meticulous sampling strategies for field work.

The centrepiece of basin studies these days is clearly geophysical basin modelling. Analyses of crustal rheology and heat flow and the development of sophisticated computer programs to run iterative simulations of crustal stretching and loading have come together to yield a powerful methodology for modelling basin structure and stratigraphy under a variety of tectonic conditions. Dan Mackenzie at Cambridge, the Lamont group, and the Canadian "school" led by Charlotte Keen, have been in the forefront of this work, and it was gratifying to see the latter represented by Chris Beaumont, who presented a review of his elegant study of the Appalachian foreland basin, Michigan Basin and Illinois Basin, recently published with Gary Quinlan in *Canadian Journal of Earth Sciences*. George Klein, Gerard Bond and Sierd Cloetingh gave related talks, that by Cloetingh presenting a fascinating study of the intraplate stresses set up by oblique plate collision and the varying rates of subduction caused by the differences in age of the subducting crust. These subtle stress differences account for intraplate earthquakes and may cause significant tilting, leading to

regionalsea-level changes. The climax of the geophysical papers was an exhaustive review of modelling studies of the North Sea by Julian Thorne. He has corrected inaccuracies in earlier models (such as that by Sclater and Christie) by avoiding as many generalizations as possible (for example, average sediment compaction factors) and building in immense quantities of hard data from wells and seismic sections, an effort that must have required huge amounts of computer time. After this exhausting paper it is hard to see where geophysical models could go next. Perhaps we have already seen this effort peak, with the law of diminishing returns about to be invoked.

Two interesting talks on the relationships between foreland thrusting and sedimentation were given by Teresa Jordan and Jim Steidtmann. Teresa discussed the methods of deriving information on fault timing and tectonic history from the sedimentary record, and Jim applied some of these ideas to an unravelling of the complex foreland basin thrust history of the Rocky Mountains area.

That basin evolution is controlled by plate tectonic setting is now a "given", but there remains much mopping-up to be done. Karen Kleinspehn discussed the contribution that sedimentological studies can make in the sorting out of complex docking histories in areas of accreted terranes. Neil Lundberg described the attempt of the Republic of China (Taiwan) to subduct the People's Republic, an actual geological episode that has amusing political echoes. Ken Hsu presented an interpretation of the origin of the large basins of western China as Permo-Triassic back-arc basins, an idea that has considerable implications for their petroleum potential as it had long been assumed that they were nonmarine basins situated over accreted microplates (their continuation as nonmarine foreland successor basins in the Cretaceous and Cenozoic is not in question).

Laboratory studies received a thorough airing on the second day, when we were treated to several presentations on trace element geochemistry and geochronology. Modern mass-spectrometry can fingerprint detrital grains and provide comparative data on potential source terrains. However, as Paul Heller explained, the data sometimes raise more problems than they solve. Noye Johnson is the leader of an impressive team project to study the Siwalik sediments of northern Pakistan. He and his co-workers gave two papers. Magnetostratigraphy is used to provide a refined chronostratigraphic control, yielding fascinating insights as to fluvial architecture, and varying sedimentation rates, while fission-track studies on detrital zircons help document source area uplift rates and unroofing history. Bill Dickinson argues that we need to think big in our studies of detrital dispersal patterns, and offered several provocative ideas about the long-distance dispersal of detritus across

different tectonic provinces into entirely unrelated basin settings.

Interestingly, facies studies received little attention at this conference. Facies models are now considered by many to be a finished subject, with little of interest remaining to be done. This is clearly not the case, as three papers set out to demonstrate. Chris Paola described his attempts to understand fan-gravel sedimentation by the use of fluid hydraulic models. Mary Kraus described an elegant study of paleosol maturation which has led her to propose the new subject of pedofacies analysis. My own contribution was to point out the inadequacies of vertical profile analysis and to illustrate the enormous amount of architectural detail that can be extracted from careful study of well-exposed lateral profiles through clastic sequences.

The conference ended with several papers on Precambrian topics, a subject of particular interest to our honoured guest. Ken Eriksson compared early Archean basins in South Africa and Australia, and speculated on early crustal evolution. Paul Hoffman gave one of his authoritative discourses on the application of plate tectonic concepts to Precambrian basins, and his coworker, John Grotzinger, described the superbly exposed Kilohigok Basin of Bathurst Inlet area.

At conferences like this it is interesting to swap speculations over a few drinks about where our science is going. Facies analysis is "done". Well, not quite. Eustatic sea-level change, a topic of intense excitement following the publication of the seismic work of Vail and his coworkers in 1977, seems to have entered a period of reflection and retrenchment.

It was barely mentioned at this meeting. Geophysical basin modelling may be peaking. The new bandwagon will probably be application of refined geochronological techniques to structural, stratigraphic and architectural studies, coupled with trace element geochemistry, used as a petrological tool. Let's hold another symposium on Pettijohn's 100th birthday, and see if we were right.

In the meantime the thanks of all basin analysts go to Karen Kleinspehn and Chris Paola for organizing this thought-provoking conference. The proceedings will be published in book form, and should be a best-seller.

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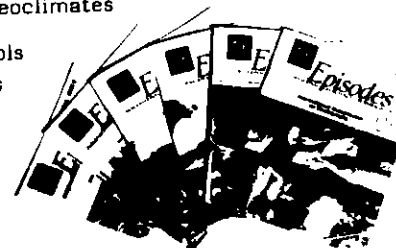
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