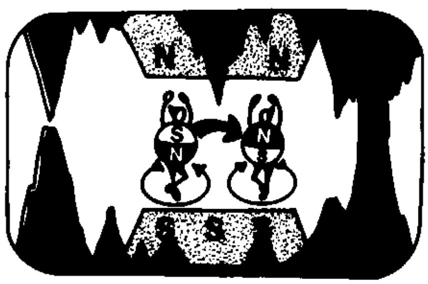
Conference Reports



ESR Dating: First International Symposium

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Although it has been known since 1967 that electron spin resonance (ESR) spectroscopy can be used to date geological materials (Zeller *et al.*, 1967), it was not until 1975 that attention was once again drawn to this method by Ikeya who applied it to dating of speleothems (calcite deposits in caves). Since then ESR has been successfully applied to various fields in geology and archaeology (Hennig and Grün, 1983). Starting in 1982, advances in ESR dating have been reported at the conference series "Specialist Seminars on TL and ESR Dating", which are held about every two to three years. The last took place in September 1984 in Worms, Germany (proceedings will soon be published in an issue of the journal Nuclear Tracks); the next will be 1987 in Cambridge. In 1985, however, Prof. Ikeya organized the first Symposium on ESR Dating at his home university in Ube, Japan. It took place on 1-4 September and the authors represented Canada and Germany at the symposium.

A total of about 45 papers were presented (20 more papers will be added in the proceedings) by about 100 participants. The majority of the participants were Japanese, but, thanks to the great effort to Prof. Ikeya, about 20 scientists from 10 other countries were also able to attend this meeting.

ESR spectroscopy is a well-established method used extensively in chemistry and biology since 1945, and only a few papers dealt with improvements in techniques of ESR spectroscopy or its apparatus. The focus of this symposium was the application of the method to geology, archaeology, and medical dosimetry. Compared with other well-established dating methods such as radiocarbon, uranium-series, thermoluminescence (TL) or amino acid racemizaticn (AAR), the application of ESR to the earth sciences is still not very well known, even though by now a few hundred papers dealing with ESR dating have been published. Therefore we shall give a brief introduction to the method.

ESR spectroscopy allows the detection of unpaired, paramagnetic, "free" electrons, which are generated by natural radiation (alpha-, beta-, gamma-, and cosmic rays). These free electrons can be stabilized by various traps in a crystal lattice. With continuing natural radiation the number of trapped electrons increases steadily and, consequently, so does the ESR signal, which is proportional to the population of free electrons. This can be represented by the following equation:

$$\text{Age (a)} = \frac{\text{accumulated dose (AD)(Gy)}}{\text{annual dose }(D_0)(\text{Gy a}^{-1})}$$

The accumulated dose (AD), which the sample received since the time of its formation is evaluated by ESR spectroscopy using the additive dose method, which was developed for TL dating: aliquots of the sample are irradiated with successively larger gamma-doses causing the ESR signal to increase. The plot of ESR intensity against artificial gamma dose allows the determination of AD by extrapolation. (The SI unit of dose is Gray (Gy) ~100rads). The annual dose (D_0) is given by the sum of the external dose (based on cosmic ray dose plus radioactivity from U, Th, and K in the soil) and the internal dose obtained from analyses of the U-, Th-, and K-contents of the sample. For details, see Ikeya (1978) and Hennig and Grün (1983).

The papers of the conference were devoted to three main topics: (1) secondary carbonates; (2) biological materials (bones, teeth and corals); and (3) volcanic minerals and fault dating.

(1) Secondary carbonates. The thermal stability of ESR signals in calcite and aragonite allows the dating of Quaternary samples of these minerals, up to about a million years in age. ESR dating of speleothems can give information directly about paleoclimate, as well as provide a time scale for other paleoclimatic records. Applications of this principle were presented in papers by Morinaga *et al.* (Kobe U.), Smart *et al.* (U. of Bristol) and Grün (McMaster U.). ESR dating of shells and corals can provide a chronology for the reconstruction of paleo sea-levels, as reported by Koba *et al.* (Kansei U.), Ninagawa *et al.* (Okayama U.), and Skinner (Williams College). Most of the papers in this section demonstrated good agreement between ESR dates and the results of independent dating methods such as U-series or radiocarbon.

(2) Biological material. Attempts to apply ESR dating to bones and teeth have encountered various problems, particularly the timing of uptake of uranium by the bone and tooth material. Nevertheless, significant progress in this field was demonstrated in papers presented during this session. Dating of bones was discussed by a Chinese group headed by Pei Hua (U. of Science and Technology, Hefei, China), and by Dennison *et al.* (U. of Otago) and Caddie *et al.* (U. of Queensland), while papers on dating of tooth enamel were presented by Schwarcz and Zymela (McMaster U.) and Chong (Nagoya U.). Tatsumi *et al.* (Atomic Disease Institute, Nagasaki U.) as well as Hoshi *et al.* (Research Institute for Nuclear Medicine, Hiroshima U.) documented the use of human tooth enamel as a natural dosimeter, to monitor the radiation exposure history of survivors of the atomic bomb attack at Hiroshima.

(3) Volcanic minerals and fault dating. The relative geological youth of the island of Japan with its young volcanoes and recent tectonic activity inspired many Japanese groups to apply ESR dating to volcanic minerals and intrafault material. The thermal stability of trapped electrons in quartz raises the possibility of dating quartz ranging in age up to several hundred million years. It could be shown by the groups headed by Ito (Tokyo U.), Tanaka (INA Civil Engineering Consultants, Tokyo) and Kosaka (Nihon U.) in a trilogy of papers, that fault movement can set the ESR signal in quartz to zero, and that ESR dating of appropriately selected samples can be used to reconstruct the tectonic history of a fault zone. There was, for example, good agreement between the sequence of displacements as shown by cross-cutting relationships of the faults, and the dates obtained using ESR. These investigations are of great importance in view of the current need to identify stable ground for construction of nuclear power plants.

At the end of the meeting, the participants were taken on a field trip to the Akiyoshi Plateau, a karstic region close to Ube, where we visited a spectacular cave, from which Prof. Ikeya had previously obtained some of the first stalactites which he dated using the "revived" method of ESR. We then retired to a nearby hotel where we were revived by repeated immersions in the waters of a hot spring.

At the conclusion of the meeting, it appeared to most of the participants that ESR dating has been well established as a method of dating Quaternary secondary calcites and shows promise of becoming a good method for dating fault movements, at least as long as quartz is present in the fault gouge. Slower, but steady, progress has been made on the dating of bones and teeth, as well as on quartz, plagioclase and other minerals. Since ESR is in a very rapid stage of development, we expect to hear about many new applications at the next TL-ESR conference in Cambridge, as well as at the Second International Symposium on ESR Dating, which will hopefully be held in Munich in 1987 or 1988.

Proceedings of this symposium will be probably published in early 1986 by Ionics Press, and can be ordered from M. Ikeya (Technical College, Yamaguchi University, Tokiwadai, Ube 755, Japan).

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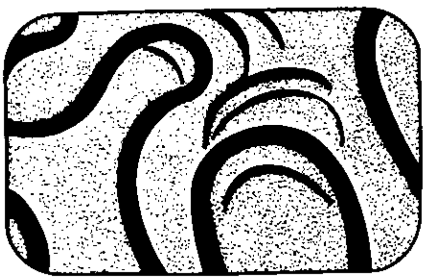

Third International Fluvial Sedimentology Conference

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Eight years after the First International Fluvial Sedimentology Symposium held in Calgary, 1977, the Third Conference held 7-9 August 1985, at the Colorado State University campus in Fort Collins, Colorado, became truly international. Participants represented 21 countries, with most (200 +) coming from the United States. Canada and the United Kingdom were well represented with 16 and 19 participants, respectively. Other countries represented were Guyana, Norway, Scotland, Germany, Poland, The Netherlands, France, Italy, Spain, Union of South Africa, Israel, Oman, India, Singapore, Australia, New Zealand, China and Japan, making this gathering the most international of the three meetings. Substantial new representation from southeast Asia, hopefully, will become a growth trend.

Superb organization by Frank Ethridge and Romeo Flores and their organization committee, Stan Schumm, Mike Harvey, Colin Thorne, Mary Kraus and Jean Weaver, resulted in a conference with 60 papers, 65 posters, 6 major field trips and a banquet. An abstract volume and field trip guide book are currently available. A special publication of conference papers, tentatively titled *Advances in Fluvial Sedimentology*, to be edited by Romeo Flores, Frank Ethridge and Mike Harvey, will be published by the Society of Economic Paleontologists and Mineralists,in the new large format, and should be available in late 1986 or early 1987.

Paper presentations and posters were divided into the following themes: sediment transport in modern rivers, facies models in coarse-grained fluvial deposits, facies models in fine-grained fluvial deposits, fluvial sediments and tectonics, and fluvial architecture and economic applications.

From the paper and poster sessions several trends and new ideas were presented. The brightest new idea by G. Smith and R. Shepard was an alternative hypothesis to explain the formation of horizontal or flat-bedding sedimentary structures in sand They suggest hyperconcentration flows (high in suspended and bed load) as an explanation; such conditions could easily be tested in experimental flume conditions. Fluvial architecture to explain the "big picture" continued as a "growth industry". Such an approach will be difficult to use by the applied oil and gas geologists who work at small scale with little data. Some papers stressed lateral facies changes as requiring more attention. Research on modern depositional systems continued to be in decline. There was even less mentioned about facies models, although two sessions were devoted to such themes. At this rate it is unlikely that facies models will be mentioned at the fourth symposium. Collinson and Lewin concluded from the second fluvial symposium that "the very complexity and variability of fluvial sedimentation will make general facies models so unrealistic as to be often worthless". With so little work in progress on modern fluvial systems, I am not optimistic about new advances or better explained facies models at the next symposium in Spain.

The conference offered six well-run field trips, which included the following: (1) The Catskill Magnafacies of New York State by J. Bridge and E. Grodon; (2) Upper Jurassic/Lower Cretaceous and Paleocene Alluvial Sediments of the Bighorn Basin, Northwest Wyoming by M. Kraus, T. Brown, E. Kuale and C. Vondra; (3) Field Guide to the Upper Salt Wash Alluvial Complex by F. Peterson and N. Tyler; (4) Guide to the Field Study of Alluvial Fan and Fan-Delta Deposits in the Fountain Formation (Pennsylvanian-Permian), Colorado by L. Suttner, R. Langford and G. Mack; (5) Holocene Braided Streams of Eastern Colorado and Sedimentological Effects of Lawn Lake Dam Failure, Rocky Mountain National Park by M. Harvey, S. Crews, J. Pitlick and T. Blair; (6) Hydraulics and Sedimentologic Processes in the Calamus (Nebraska Sand Hills): a field workshop by N. Smith and J. Bridge.

The highlight of the banquet was speaker John Costa who presented a wonderfully humorous slide show about pitfalls of field research. Perhaps the most important function of such a meeting is the good fellowship which occurs between colleagues, who rarely get together except at such meetings, and field trips in such relaxed physical settings.

The conference concluded with a near unanimous vote to accept the invitation by the Spaniards to host the Fourth International Fluvial Sedimentology Symposium at Barcelona, Spain, in 1989. Attendance at Spain will be high because of the field trip opportunities to the variety of well-exposed fluvial rocks in the nearby Ebro Basin, just west of the city.

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