

RUDIST CONGRESS REPORT

The 6th International Rudist Congress in Rovinj, Croatia September - October 2002

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The 6th international Rudist Congress was held in Rovinj, Croatia (see inset Figure 1) from September 29 to October 5, 2002. It was of particular relevance to geologists studying rudists of the Middle East, especially those of the Shu'aiba Formation, Saudi Arabia.

The theme of this series of congresses is the exchange of knowledge on the taxonomy, shell structure, biostratigraphy, evolution, paleobiogeography, paleobiology, stable isotope analysis, paleoecology, and modern analogs of rudists, as well as the sedimentology and stratigraphy of rudist-bearing strata and their associated microfossils. For a specialist group, the conference was well supported with 48 delegates from universities and industry representing 21 countries. Of the 48 presentations, 28 were oral and 20 were based on poster displays.

The conference provided an opportunity for oil company geologists to share observations and interpretations with international rudist experts. A variety of topics were discussed, including studies

on rudist paleoenvironments, taxonomy, and stable isotopes from Saudi Arabia, Egypt, Algeria, Tunisia, Croatia, Slovenia, Serbia, Albania, Turkey, Italy, France, Spain, Mexico, Jamaica, Costa Rica, and Peru. This provided positive feedback on the current concepts being developed for the depositional model of the Shu'aiba Formation.

An excursion to the Istrian Peninsula allowed participants to examine rudist-bearing sequences (for example, Figure 1) in the field and to debate the depositional environments. The field discussions were relevant to the Shu'aiba Formation. An abstract volume and an excursion guide were presented to the participants (Vlahovic and Korbar, 2002).

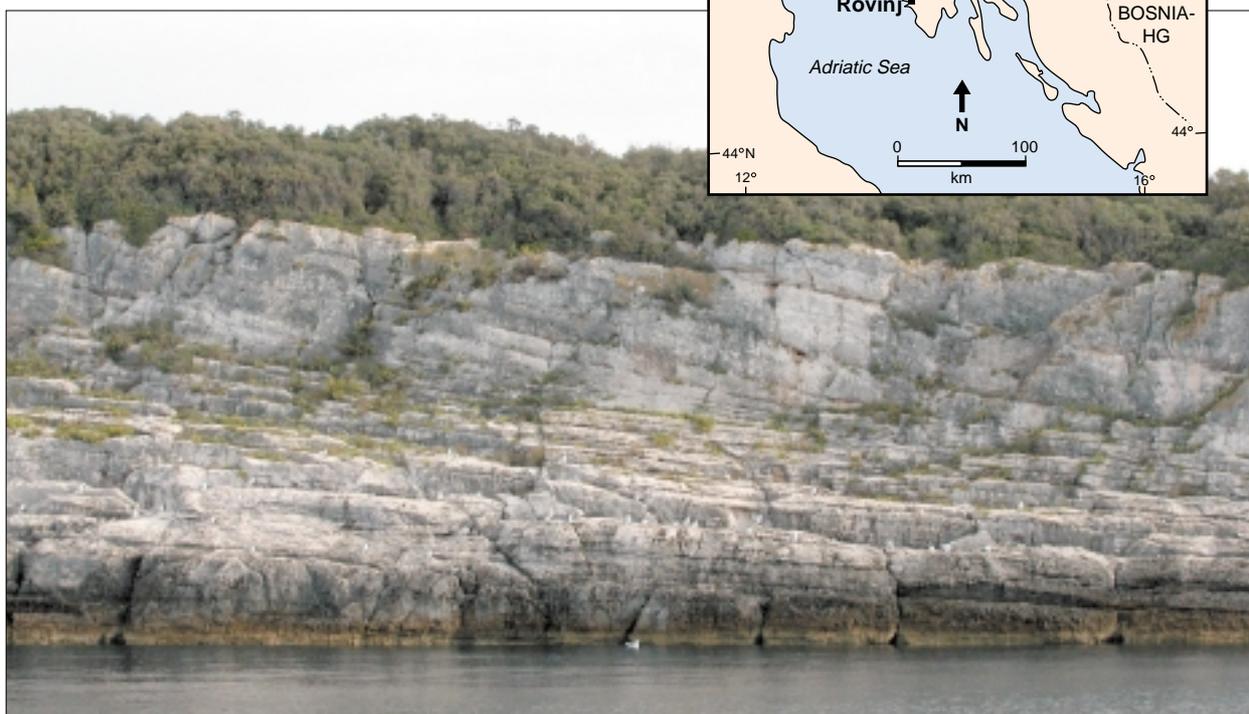


Figure 1: One of the excellent coastal exposures visited during the field excursion to the Istrian Peninsula.

CONFERENCE

Aspects of age control and the time required for rudists to accumulate were presented in several papers. Estimates of individual rudist growth rates using sclerology range from 1.5 cm/year (*Biradiolites*), 3.5 cm/year (radiolitids), to 7 cm/year (requienid rudists) (Regidor-Higuera et al., 2002). These high growth rates imply that there were major hiatuses between rudist beds, to account for the relative thin deposits of coarse-grained sediments spanning long time intervals. Rudist growth lines (radiolitids) display 24 lines per year, and represent bimonthly biorhythms. Some rudists were found to be 15 years old. Sr isotope analyses of rudists have enabled accurate dating within the Aptian, using the well-defined Sr isotope standard (Steuber, 2002). This method relies on the carefully sampled outer calcitic part of rudists and not any bulk or mixed sediment.

A relationship was observed between rudist shell type, packing density, and sediment texture (Masse and Fenerci-Masse, 2002). In grainstones, large shells were typical, small thick shells characterize packstones and wackestones, with small thin shells

in wackestones. Another presentation showed rudists growing on stromatoporoids. Excellent specimens of Kimmeridgian and Tithonian rudists from France were displayed (Gourrat et al., 2002). Their absence from the Arab Formation of Saudi Arabia may be due to a relatively restricted environment, as they are apparently present in Oman and the United Arab Emirates. The Composite Standard approach (used where there is good age control) could be of interest by selecting the most comprehensive well as a reference (Scott, 2002).

In a presentation on the potential use of the two *Agriopleura* morphotypes or species in depositional layer definition in the upper part of the Shu'aiba in the Shaybah field of Saudi Arabia, Hughes (2002) provided the first micropaleontological evidence for different environmental regimes associated with *A. marticensis* and *A. blumenbachi*. Discussions regarding the validity of two species versus simple morphological variation centered on a need for detailed analysis of the respective internal morphologies. Dr. P. Skelton (Open University, UK)

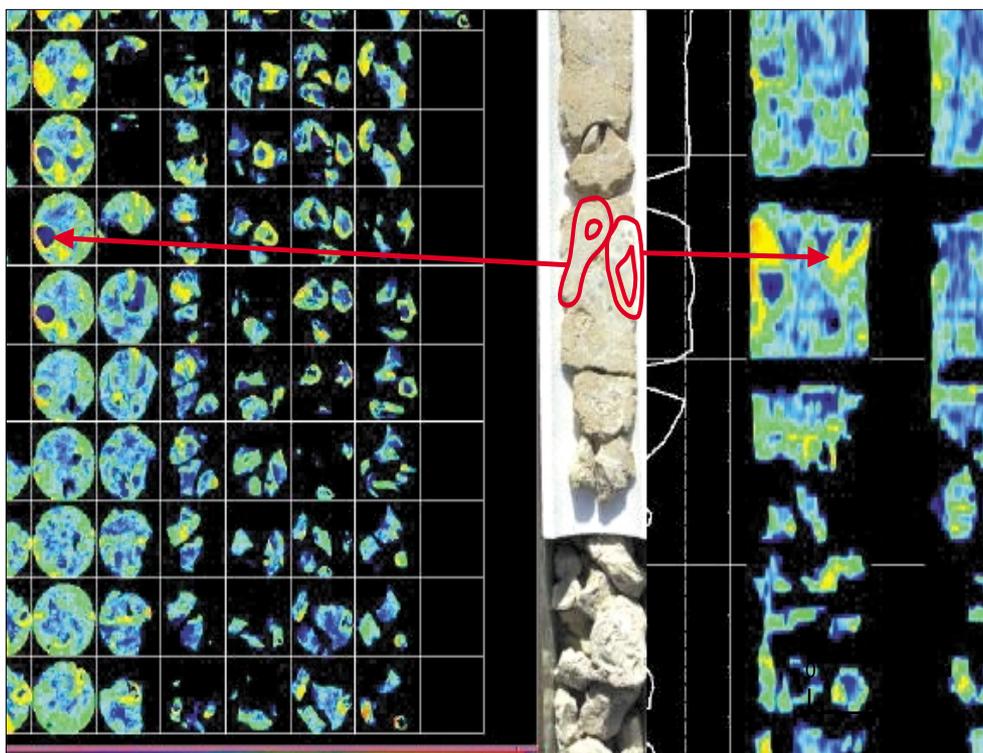


Figure 2: *Agriopleura* cf. *marticensis* from the upper part of the Shu'aiba Formation, Shaybah field. This unusual specimen had a horizontal clinger life style, instead of the conventional vertical, elevator growth. The enlarged growth lamellae on the lower side of the valve are firmly encased in the sediment, and their absence on the upper part of the valve is noteworthy.

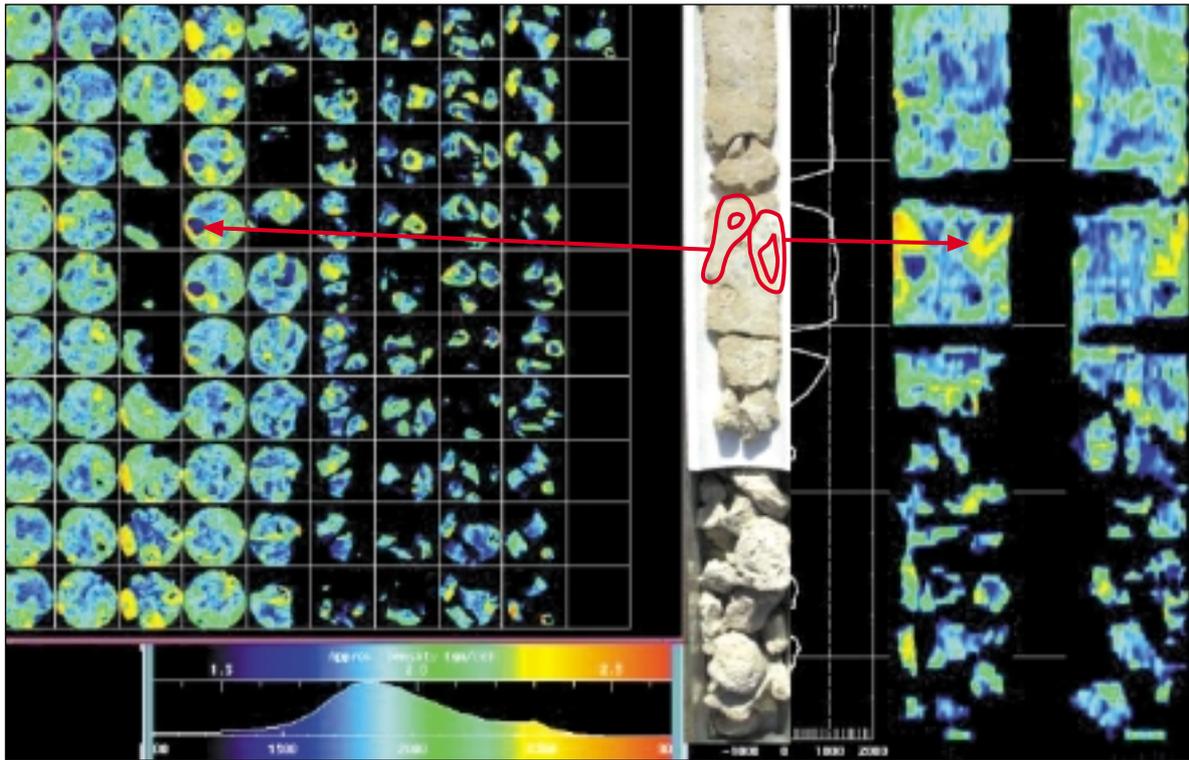


Figure 3: CT scan and photograph of 3 ft of core from a well in the Shua'iba Formation of the Shaybah field, Saudi Arabia. Specimens of the conventionally recumbent caprinid rudist *Offneria murgensis* have a vertical growth position, and their low-density valve center is easily recognized on the CT scan.

offered his expert assistance to assist with this investigation. The taxonomic aspect is not critical, as both forms can easily and pragmatically be distinguished simply by their 'V' or 'U' shape in vertical section, although it would be preferable to have a final decision on their taxonomy.

A specimen of *A. marticensis* from a recently cored well on the east flank of the Shaybah field was found in a horizontal position and with anomalous asymmetrical growth lamellae. This suggested a new life style rather than the conventional elevator growth position for this genus. Its presence at this location has the potential for refining the depositional environment of the uppermost part of the Shu'aiba Formation at Shaybah (Hughes, 2000). A photograph of this specimen (Figure 2) led the experts to agree that its growth position was horizontal, and that it was a 'clinger'. It was interpreted as having adapted to a higher than normal energy regime and a dominant current direction, unlike the lower energy environment associated with the elevator habit in the deeper platform conditions of the upper part of the Shu'aiba.

Similarly, the observation that the traditionally 'recumbent' growth style of *Offneria murgensis* was occupying an 'elevator' position at the same, but stratigraphically lower location, was accepted as such by the experts. There was a consensus that this type of life-style shift was not unusual in some types of rudists. The elevator habit of the fast-growing *O. murgensis* may represent adaptation to a high rate of sedimentation within the fore-bank regime.

An illustrated presentation on the interpretation of rudist species and their taphonomy from Computerized Tomography (CT) scans of Shu'aiba cores from the Shaybah field (Figure 3) (Hughes et al., 2002) was received with much interest, as it represented the first instance of rudist identification by remote sensing. The paper was considered as a good example of how the Congress was keeping pace with modern technological developments. The CT scans permit the recognition of rudist biofacies and the interpretation of paleoenvironments prior to core slabbing, as it presents an undisturbed image of the internal rudist fabric of the core.

The predominance of left (free) valves of the elevator rudist *Glossomyophorus costatus* beneath the *Offneria murgensis* breccias in the Shu'aiba Formation of the Shaybah field was considered to be consistent with mass transport. This possibly occurred during a storm or within a channel, where the easily disassociated valves could have been transported from their site of growth. Assemblages consisting predominantly, or entirely, of fixed valves of this species are to be expected, and they would represent the residual biofacies after the winnowing away of the easily disassociated free cap-like left valves.

FIELD TRIP

Croatia offers excellent coastal and quarry exposures for the study of rudist and *Lithocodium* facies that compare well with those interpreted for the Shu'aiba reservoir. The field trip took advantage of the exposures on the Istrian Peninsula close to Rovinj.

Rudist-bearing sediments crop out in a 300-m-long coastal section on Frasker Island. Clinostratified



Figure 4: Vinkuran Quarry. The lithostratigraphic unit of the coastal exposures (Figure 1) is exposed in the quarry face.

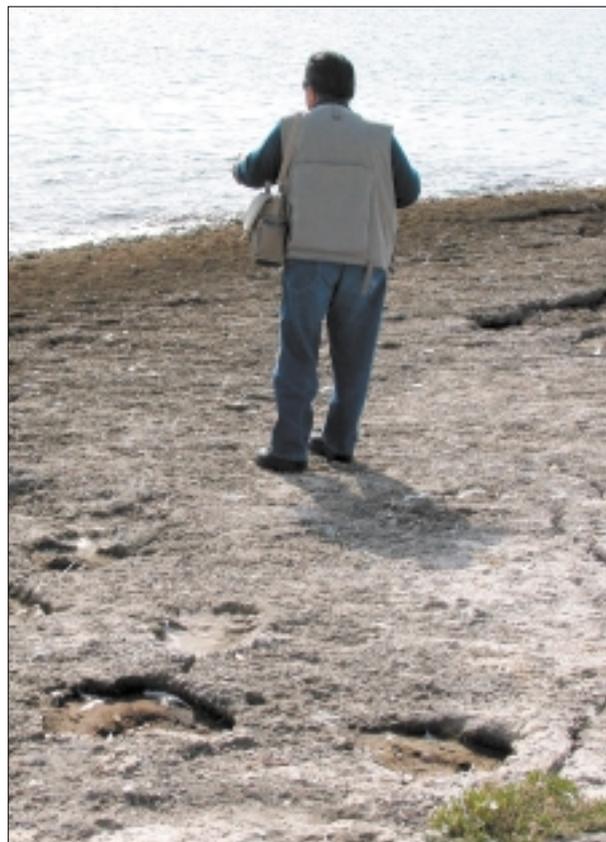


Figure 5: Dinosaur footprints, Fenoliga Island.

bodies composed of reworked lower to middle Cenomanian rudist debris and fine-grained bioclasts have prograded at 12° to 15° over Albian sediments (Figure 1). The section provided an insight into the potential rudist-bed configuration within the lower Aptian Shu'aiba Formation on the flanks of the Shaybah field.

The lithostratigraphic unit that crops out in the coastal section was later examined in the Vinkuran Quarry. The quarry face exposes dark, rudist-free grainstones and wackestones capping graded beds of transported rudists (Figure 4). These were explained as storm deposits despite the presence of rare, in situ, elevator rudists (as is possibly the case in the upper part of the Shu'aiba reservoir on the east flank of the Shaybah field). The overlying facies contain sponge/coral masses (one of which included a nerineid gastropod). The entire section shoaled upward into a stromatolitic succession.

Peritidal (subtidal) tabular rudist bodies on Fenoliga Island had radiolitid rudist caps. The 1-m-thick beds contain *Chrysalidina* (cf. *Praechrysalidina* in the upper Shu'aiba), and were considered to be representative of only moderately deep water.



Figure 6: Mud mound on Fenoliga Island.

Dinosaur footprints on the same beds nearby indicated subsequent very shallow, intertidal to shallow subtidal conditions. The footprints in Figure 5 are on the upper bedding plane of a radiolitid rudist biostrome of middle to late Cenomanian age. Two mud mounds at this locality showed well-developed draping of the overlying beds (Figure 6). The mounds contain rare middle to late Cenomanian radiolitids that may have assisted in the development of the mound by acting as sediment baffles.

The lower Aptian Kanfanar Formation was examined in the Kanfanar Quarry. The lower part of the succession contained microfaunas identical to those of the Biyadh in the Shaybah field, and was overlain by beds of *Lithocodium aggregatum*. The *Lithocodium* beds also contain the foraminifera *Debarina hahounerensis*, *Vercorsella arenata*, *Praechrysalidina infracreatacea* and *Salpingoporella dinarica*, as in the basal Shu'aiba Formation. These 1- to 1.5-m-thick beds typically have a burrowed upper surface, which suggests episodes of non-

deposition or the development of submarine hardground. Small elevator rudists (*Toucasia* and requienids) are also present, but the characteristic Shu'aiba rudist genera *Glossomyophorus* and *Agriopleura* are absent.

Micropaleontological evidence was available for most of the exposures, and this enabled an even closer comparison with the micro- and macrofaunal studies of the Shu'aiba. The exposures visited are excellent localities at which to display to geologists and engineers the three-dimensional aspects of many of the sedimentary facies of the Shu'aiba reservoir. Unfortunately, the rudist shoals at the platform margin are not located onshore Croatia, but the lagoonal shoals, *Lithocodium* facies and shallow intra-platform shoals with their prograding beds are well exposed. Beds typical of storm generation are also well developed, and are of significance for comparison with Shu'aiba assemblages in which bedding dips are visible both within the cores and on the Formation Micro-Imager.

ACKNOWLEDGMENTS

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ABOUT THE AUTHOR

G. Wyn Hughes is a Senior Geological Consultant in the Geological Research and Development Division of Saudi Aramco. He received his BSc, MSc, and PhD degrees from Prifysgol Cymru, University of Wales. His nearly 30 years of experience in biostratigraphy include 10 years as a Field Geologist/Biostratigrapher with the Solomon Islands Geological Survey, and 10 years as a Biostratigraphic Consultant and Unit Head of the Middle East-India region with Robertson Research International based in Singapore and Wales. Wyn's professional activities are focused on the integration of micropaleontology with sedimentology to enhance sequence stratigraphic interpretations of Saudi Arabian carbonate rocks. He maintains links with academic research through his activities as an external examiner for the University of Wales and as an Adjunct Professor of the King Fahd University of Petroleum and Minerals, Dhahran. Wyn is a reviewer for GeoArabia, and a member the British Micropaleontological Society and Dhahran Geoscience Society, and a Fellow of the Cushman Foundation for Foraminiferal Research.



The proceedings of the Congress will be published in *Geology Croatia* by the end of 2003. The 2nd International Association of Sedimentologists meeting will take place in Opatia, Croatia, from September 17 to 19, 2003 (www.irg.hr/ias2003). It will deal with Permian to Quaternary sediments. The International Geological Congress will be held in Florence, Italy in 2004, with a special meeting on the stratigraphy and biostratigraphy of Cretaceous carbonate platforms. The 7th International Rudist Congress will take place in Texas during late May or early June 2005, and will be arranged by B. Scott and A. Molyneux.