

Advances in coralline algae research: insights from the *IV International Rhodolith Workshop*

The *IV International Rhodolith Workshop*, held in Granada (Spain) in 2012, was the continuation of a series of meetings that started with the first workshop at Cumbrae Isle (Scotland, United Kingdom) in 2000. After that scientific event, the second rhodolith workshop took place in La Paz (Baja California Sur, Mexico) in 2006 and, the third in Búzios (Brazil) in 2009. The *IV International Rhodolith Workshop* of Granada was organized by Julio Aguirre, Juan C. Braga and Anja Rösler (Universidad de Granada). In addition to the organizers, a scientific committee composed of seven well-known experts from different institutions was selected:

- Rafael Riosmena-Rodríguez, Universidad Autónoma de Baja California Sur (Mexico)
- Line Le Gall, Muséum National d'Histoire Naturelle, Paris (France)
- Nicholas Kamenos, Glasgow University (UK)
- Davide Bassi, Università di Ferrara (Italy)
- Diana Steller, Moss Landing Marine Laboratory, California (USA)
- Markes Johnson, Williams Collage (USA)
- Jorge Ledesma, Universidad Autónoma de Baja California, Ensenada (Mexico)

All the work carried out by both the organizers and the members of the scientific committee was sincerely appreciated.

The meeting was held in September 17-21, 2012. The 17th and 18th were dedicated to oral and poster presentations. There were a total of 51 presentations spanning the variety of research currently carried out on coralline algae. Presentations were followed by fruitful discussions between attendants and authors of presentations. At the end of the scientific expositions, Rafael Riosmena-Rodríguez presented a proposal to produce a book on rhodolith/maerl beds, including both recent and fossil examples. There was a general call to collectively participate in the book and, finally, it is now in progress. The book, entitled “Rhodolith/Maerl Beds: A Global Perspective”, will be coedited by Rafael Riosmena-Rodríguez, Wendy Nelson and Julio Aguirre and is expected to be published in the course of 2014 by Springer, Coastal Research Library (series editor Charles W. Finkl).

In addition to the scientific sections, two field trips were organized. The first excursion was held in September 19, and was dedicated to visit recent rhodolith beds off La Herradura (Almuñecar, coast of Granada, S Spain). The purpose of this day was to dive in the small Marina del Este and La Calita bays in La Herradura where rhodolith beds occur on gravelly bottoms, from –15 to –20 m depth.

The second excursion was a two-days field trip in Almería province (SE Spain) in September 20-21. The topics were to visit both fossil and recent rhodolith beds. The first day was devoted to study upper Tortonian (late Miocene) rhodolith beds in the Almanzora Corridor Basin (Almería, SE Spain), a narrow and E-W elongated Neogene intermontane basin of the Betic Cordillera. Different rhodolith beds were developed within sandy/silty prograding fan-delta deposits during relatively inactive periods.

During the second day, two excursions were proposed. One group visited the living rhodolith beds on the platform off El Plomo, a site located 2.5 km south

of Agua Amarga, at the eastern coast of Almería (SE Spain). In the area, rhodolith beds are extended from -20 to -50 m depth and occur in a sandy area associated with fleshy algae and invertebrates. In addition to rhodoliths, coralline algae also occur as encrusting forms overgrowing shells, fragments of invertebrate skeletons as well as rock fragments. The other group visited fossil rhodolith beds and coralline algal bioconstructions in the Carboneras Basin, a small Neogene intermontane basin located at the northeastern margin of the Cabo de Gata volcanic province (SE Spain). In this basin, rhodoliths are one of the most abundant biotic components of the lower Pliocene carbonate deposits that filled up the basin. Rhodolith beds were developed in different environmental and sequence stratigraphic contexts, thus providing a unique record to understand the founding conditions and the key factors to maintain the continuous and successful development of thick densely-packed rhodolith beds. Further to the rhodolith beds, coralline algae, together with bryozoans, bivalves and vermetids, formed extensive and irregular bioconstructions.

Although the title of this scientific event series seems to limit the participation of scientists working exclusively on rhodoliths, it actually deals with coralline algae in general. In this respect, it gives the international scientific community a unique scenario to be updated and to discuss advances in coralline algae research. The Rhodolith Workshops have therefore attracted a wealth of researchers with diverse scientific backgrounds and from countries all over the world. That was, once more, the case of the *IV International Rhodolith Workshop*, where ecologists, taxonomists, molecular biologists, geneticists, palaeontologists, sedimentologists, environmental managers, etc., working on coralline algae met together. Studies covering different topics were presented at the workshop, including descriptions of new rhodolith beds, ecology and long-term stability of present-day rhodolith beds, associated dwelling fauna and flora to rhodolith beds, growth rates of coralline algae, ocean acidification as a stressing factor for rhodolith bed development, molecular and DNA studies of coralline algae, biochemical analyses on forming-rhodolith coralline algal taxa, effect of sediment burial on rhodolith survival, coralline algal taxa forming rhodoliths in particular rhodolith beds, biogeographic distribution of coralline algal species, fossil rhodolith beds and palaeoenvironmental conditions in which they were formed, and sedimentary contexts in which fossil rhodolith beds were developed.

Both the scientific presentations and the field trip guide can be downloaded from: http://www.ugr.es/~estratig/rhodolith/08publication_manuscripts.html.

In terms of participation, 45 scientists from different universities and research institutions attended the *IV International Rhodolith Workshop*. They came from twelve countries: Australia, Brazil, France, Germany, Ireland, Italy, Mexico, New Zealand, Portugal, Spain, The United Kingdom, and The United States. In light of this success, rhodolith workshops will continue in the future and the next meeting, the *V International Rhodolith Workshop*, will be held in Costa Rica and will be organized by Dr. Cindy Fernández (Universidad de Costa Rica).

A selection of six papers is presented in this special issue of the **Cryptogamic, Algology** dedicated to the *IV International Rhodolith Workshop* of Granada. Some of these papers focus on new insights of particular coralline algal taxa, such as the first finding of *Sporolithon molle* in the offshore Trinidad Island at the southwest Atlantic (Bahia *et al.*, 2014), and the record of gametangial plants of *Phymatolithon calcareum* in Brittany that were confirmed by anatomical and genetic (DNA barcodes) data (Peña *et al.*, 2014). Nelson *et al.* (2014) analyse the macroalgal diversity associated with two rhodolith beds in New Zealand; one bed dominated by *Lithothamnion crispatum* rhodoliths growing in clear waters and the

other bed formed by *Sporolithon durum* rhodoliths in turbid waters. Hinojosa-Arango *et al.* (2014) apply geographic information systems (GIS) and remote sensing to stress on the necessity to preserve rhodoliths and *Sargassum* spp. habitats for conservation of economic activities. The paper by Villas-Boas *et al.* (2014) deals on the effect of sediment burial and light reduction on the survival of the rhodolith-forming species *Mesophyllum engelhartii* and *Lithothamnion* sp. Finally, Fredericq *et al.* (2014) present a qualitative and observational study, with speculative hypothesis to be tested with further experimental work, on the dynamic of rhodoliths and associated diversity following the catastrophic anthropogenic oil spill in the northwestern Gulf of Mexico. All these papers have been subjected to peer-review by specialists in the different topics who have improved the scientific quality of the contributions. Their work and effort is very much appreciated since they have been essential for the high quality of the final manuscripts. We also want to express our gratitude to Dr. Line Le Gall, one of the editors of the **Cryptogamie, Algologie**, for her kind willingness and assistance in publishing the meeting results on this special issue of the journal.

The *IV International Rhodolith Workshop* took place in the Departamento de Estratigrafía y Paleontología at the University of Granada (Spain), and we want to acknowledge all the facilities and help of the head, as well as the secretary, of the Department. The meeting also benefited from the support and the collaboration of the Facultad de Ciencias and Universidad de Granada.

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