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Exported reef sediments: an underestimated parameter in reef carbonate production evaluation. The Upper Jurassic example of the central Apennines, Italy

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The quantitative estimate of reef carbonate production contributes to clarify the close relationships between reef ecosystem and environmental changes. Reefs, in fact, are suitable environmental monitoring systems and they are intimately related to the carbon cycle. Moreover, reef sedimentary products are important also because they may represent important hydrocarbon reservoirs.

There are different methods to quantitatively estimate reef carbonate production (e.g. hydrochemical, census, accumulation). In spite of the method and of the controlling factors, the total reefal carbonate production (Pt) is given by the sum of the carbonate net production (carbonate retained within the reef body, Pn) and the carbonate removed production (the amount of carbonate produced by the reef but chemically dissolved and exported from the reef body to adjacent environments, Pr). The amount of carbonate production removed from the reef is the most complex variable to be defined, and it makes the quantitative estimate of the total carbonate production largely uncertain.

Although carbonate dissolution could play an important role in reefs, its estimate is always a complex task, and it is generally neglected in ancient reef systems. Conversely, the amount of exported carbonates is commonly assumed to be proportional to (Hubbard et al 1990; Kiessling et al., 2000), or much more than (Maney, 1973; Land, 1979), the debris produced and retained in the reef. Therefore, the higher is the debris production retained in the reef, the higher is the carbonate production exported.

Based on this assumption, the Upper Jurassic reefs debris and export potentials are considered among the highest of the entire Mesozoic (Kiessling et al., 2000).

In order to test the linear relationship between retained and exported carbonate production, a quantitative study has been performed on an Upper Jurassic high debris potential reef of central Apennines (Italy). This is represented by a bioclastic rich unit dominated by stromatoporoids, chetetids, subordinated isolated corals and few coral colonies, floating in a medium to coarse grained matrix made up of skeletal debris, with abundant microencrusters and microbialites.

In the investigated area, the reef complex gives information on the carbonate net production, whereas slope and base-of-slope successions provide an estimate of the amount of the reef-derived carbonate export production. Results indicate that the sediment volume produced and removed from the reef body (exported production) is from one to two order of magnitude less than the sediment volume produced and retained in the reef body (net production). Obtained values are very far, about two order of magnitude lesser, from estimates expected by the linear relationship between retained and exported carbonate production.

The definition of the exported carbonate production through the volume of slope and base-of-slope reef-derived resediments, the amount of total carbonate production is very close to the net one, and it is about one order of magnitude less than predicted by the assumed retained/exported proportion. This imply that the great part of the sediment produced by the studied upper Jurassic high debris potential reef is retained in the reef body. According to the internal reef structure, this feature is interpreted to be related to the abundant presence of microencrusters and microbialiltes which, acting as bafflers and binders, promoted sediment trapping and limited sediment export.

Our results stress the fact that for a correct estimates of reef carbonate production and their interpretation, data from reef–derived slope and base-of-slope sediments can not be neglected, as the information they record contain an integrating part of the reef history.

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