Global and Planetary Change 143 (2016) 196–213

Contents lists available at ScienceDirect

Global and Planetary Change

journal homepage: www.elsevier.com/locate/gloplacha

Invited review article

Interplay between regional uplift and glacio-eustasy in the Crotone Basin (Calabria, southern Italy) since 0.45 Ma: A review

Massimo Zecchin *, Mauro Caffau, Silvia Ceramicola

Istituto Nazionale di Oceanografia e di Geofisica Sperimentale – OGS, 34010 Sgonico, TS, Italy

ARTICLE INFO

Article history:
Received 29 December 2015
Received in revised form 20 June 2016
Accepted 21 June 2016
Available online 25 June 2016

Keywords:
Glacio-eustasy
Marine Isotope Stage
Regional uplift
Crotone Basin
Marine terrace

ABSTRACT

During the last 0.45 Ma, the Crotone Basin, a forearc basin located on the Ionian side of Calabria, southern Italy, experienced a phase of uplift that persists today. The transition from subsidence to uplift occurred close to the Marine Isotope Stage (MIS) 11 (ca. 0.4 Ma). The subsequent progressive emergence of the area was punctuated by several marine transgressions linked to high-frequency, high-magnitude glacio-eustatic changes, which are recorded as coastal terraces. These high-frequency sequences show a variable stacking pattern due to the interplay between glacio-eustasy, uplift and local physiography. In particular, a progressive SE-ward migration of the shoreline is documented in the study area since MIS 11. This trend was enhanced during the MIS 5.5 to MIS 2 time interval, due to the combined effect of uplift and lowering glacio-eustatic sea level until the Last Glacial Maximum. Moreover, the regional uplift also led to a physiographic change from relatively low-gradient to high-gradient settings between MIS 7.1 and MIS 5.5. A comparison between the late Quaternary geological record of the Crotone Basin and that of other basins is crucial to improve the present knowledge on past sea levels related to MISs. This ultimately will help to better understand the Holocene sea-level history and the human contribution to sea-level change, in order to predict future scenarios.

Contents

1. Introduction . . . 196
2. Geological setting . . . 199
3. The records of late Quaternary Marine Isotope Stages in the Crotone Basin . . . 200
   3.1. MIS 11 to MIS 9 . . . 200
   3.2. MIS 7 . . . 200
   3.3. MIS 5.5 to MIS 3 . . . 202
   3.4. The Last Glacial Maximum (LGM) and the post-LGM transgression . . . 204
4. The shoreline evolution since MIS 11 . . . 205
5. Discussion and conclusions . . . 207
Acknowledgments . . . 212
References . . . 212

1. Introduction

The Middle to Late Pleistocene time was characterized by high-magnitude (up to 100–150 m) eustatic changes linked to climatic variations that produced alternating glacial-interglacial phases (Fig. 1). This phenomenon, called glacio-eustasy, is documented by the marine oxygen isotopic record (the Marine Isotope Stages, MIS) as well as by sedimentary and stratigraphic features of the deposits (e.g., Zecchin et al., 2010b). The glacio-eustasy is related to variations in Earth-orbital parameters with different periodicity (the so-called Milankovitch cyclicity), spanning between 20 and 400 ka (Hays et al., 1976). The 100 ka duration eccentricity cycle is effective since ca. 0.8 Ma (Raymo, 1997); shorter-term cycles, characterized by lower magnitude, are those obliquity- and precession-driven, respectively of ca. 40 and 20 ka duration (Dansgaard et al., 1993; Rohling et al., 1998; Siddall et al., 2003).

* Corresponding author.
E-mail address: mzecchin@ogs.trieste.it (M. Zecchin).

http://dx.doi.org/10.1016/j.gloplacha.2016.06.013
0921-8181/

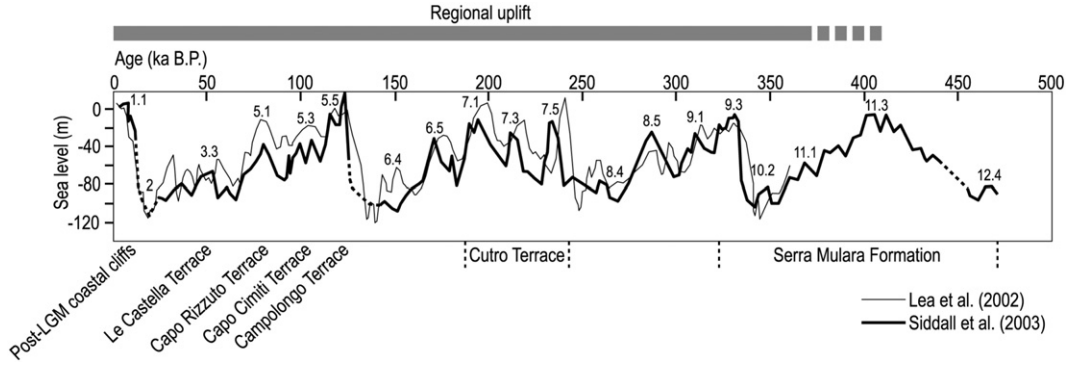

Fig. 1. Sea level curves of the last 0.5 Ma with indication of the Marine Isotope Stages (numbered). The inferred time intervals during which the Serra Mulara Formation has accumulated, and the marine terraces and the post Last Glacial Maximum (LGM) coastal cliffs have formed, are indicated below. The gray bar at the top indicates the phase of uplift of the Crotone Basin, started at ca. 0.4 Ma and persisting today (see text).
(Modified from Lea et al., 2002 and Siddall et al., 2003.)

These glacio-eustatic sea-level changes with different periodicity correlate with the MISs and with the isotope substage cyclicity (Fig. 1), and are recorded at outcrop as high-frequency sequences (Zecchin and Catuneanu, 2013; Catuneanu and Zecchin, 2013). During the Quaternary time, glacio-eustatic changes related to the substage cyclicity may be recorded as marine terraces along uplifting coastal areas. The study of the interplay between glacio-eustasy and sedimentation, therefore, is essential in order to reconstruct ancient landscapes and shorelines, and is very useful to delineate the uplift rates and the Quaternary evolution of coastal areas.

Previous studies of the more recent part (Middle to Upper Pleistocene) of the Crotone Basin succession (southern Italy), an uplifted Neogene forearc basin, have allowed to document MISs and substages within deep-marine to shallow-marine deposits (Massari et al., 2002; Zecchin et al., 2004b, 2009, 2010a, 2011a, 2011b). The alternation between glacial and interglacial phases has produced high-frequency sequences that are stacked in different ways, depending on the scale of the glacio-eustatic sea-level changes and on their interplay with tectonics and regional uplift (Zecchin et al., 2010b). However, at present the stratigraphic relationships between the high-frequency sequences linked to MISs and substages, and the reconstruction of the environmental variability due to the glacial-interglacial cyclicity, are available only for limited areas of the basin and/or for limited temporal scales.

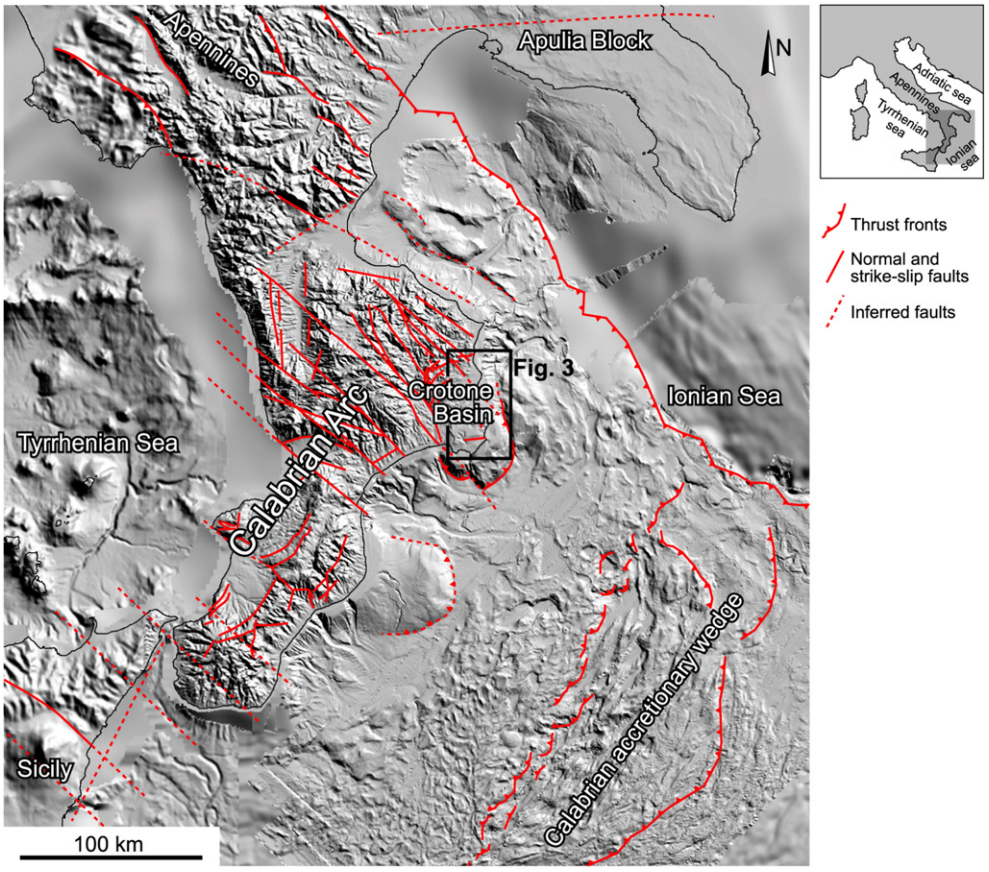

Fig. 2. DTM map showing the Calabrian Arc, positioned between the NW-trending southern Apennines and the E-trending Sicilian Maghrebides. The study area, corresponding to the Crotone Basin, is highlighted.
(Modified from Zecchin et al., 2015b.)