



Contents lists available at ScienceDirect

Palaeogeography, Palaeoclimatology, Palaeoecology

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

Review: Short-term sea-level changes in a greenhouse world – A view from the Cretaceous



B. Sames^{a,b,*}, M. Wagreich^a, J.E. Wendler^c, B.U. Haq^d, C.P. Conrad^e, M.C. Melinte-Dobrinescu^f, X. Hu^g, I. Wendler^c, E. Wolfgring^a, I.Ö. Yilmaz^{h,i}, S.O. Zorina^j

^a University of Vienna, Department for Geodynamics and Sedimentology, Geozentrum, Althanstrasse 14, 1090 Vienna, Austria

^b Sam Noble Oklahoma Museum of Natural History, 2401 Chautauqua Avenue, Norman, OK 73072-7029, USA

^c Bremen University, Department of Geosciences, P.O. Box 330440, 28334 Bremen, Germany

^d Smithsonian Institution, Washington DC, USA, and Sorbonne, Pierre & Marie Curie University Paris, France

^e University of Hawaii at Mānoa, Department of Geology and Geophysics, School of Ocean and Earth Science and Technology, Honolulu, HI 96822, USA

^f National Institute of Marine Geology and Geoecology (GeoEcoMar), Str. Dimitrie Onciul Nr. 23, 024053 Bucharest, Romania

^g Nanjing University, School of Earth Sciences and Engineering, Hankou Road 22, Nanjing 210093, PR China

^h Middle East Technical University, Department of Geological Engineering, 06531 Ankara, Turkey

ⁱ The University of Texas at Austin, Department of Geological Sciences, 2275 Speedway Stop C9000, Austin, TX 78712-1722, USA

^j Kazan Federal University, Department of Paleontology and Stratigraphy, Kremlyovskaya str. 4/5, Kazan 420008, Russia

ARTICLE INFO

Available online 3 November 2015

Keywords:

Cretaceous greenhouse

Eustasy

Relative sea-level change

Aquifer-eustasy

Sequence stratigraphy

Orbital cycles

ABSTRACT

This review provides a synopsis of ongoing research and our understanding of the fundamentals of sea-level change today and in the geologic record, especially as illustrated by conditions and processes during the Cretaceous greenhouse climate episode. We give an overview of the state of the art of our understanding on eustatic (global) versus relative (regional) sea level, as well as long-term versus short-term fluctuations and their drivers. In the context of the focus of UNESCO-IUGS/IGCP project 609 on Cretaceous eustatic, short-term sea-level and climate changes, we evaluate the possible evidence for glacio-eustasy versus alternative or additional mechanisms for continental water storage and release for the Cretaceous greenhouse and hothouse phases during which the presence of larger continental ice shields is considered unlikely. Increasing evidence in the literature suggests a correlation between long-period orbital cycles and depositional cycles that reflect sea-level fluctuations, implying a globally synchronized forcing of (eustatic) sea level. Fourth-order depositional sequences seem to be related to a ~405 ka periodicity, which most likely represents long-period orbital eccentricity control on sea level and depositional cycles. Third-order cyclicity, expressed as time-synchronous sea level falls of ~20 to 110 m on ~0.5 to 3.0 Ma timescales in the Cretaceous, are increasingly recognized as connected to climate cycles triggered by long-term astronomical cycles that have periodicity ranging from ~1.0 to 2.4 Ma. Future perspectives of research on greenhouse sea-level changes comprise a high-precision time-scale for sequence stratigraphy and eustatic sea-level changes and high-resolution marine to non-marine stratigraphic correlation.

© 2015 Published by Elsevier B.V.

Contents

1.	Introduction	394
2.	Fundamentals of relative and eustatic sea level and sea-level change.	395
2.1.	Sea level and sea-level fluctuations: classification and measurement	395
2.2.	Timescales and amplitudes of sea-level change	396
2.3.	Drivers and mechanisms of long- and short-term eustatic sea-level changes	397
2.4.	Physico-chemical intrinsic contributions: ocean water temperature and salinity – steric sea-level change.	400
2.5.	The cryospheric contribution – glacio-eustasy	401
2.6.	Continental water storage and release contributions	401
2.7.	Solid-Earth contributions	403
2.8.	Geoid contributions	404
2.9.	Reconstructing sea-level changes in the geologic record	404

* Corresponding author at: University of Vienna, Department for Geodynamics and Sedimentology, Geozentrum, Althanstrasse 14, 1090 Vienna, Austria.
E-mail address: benjamin.sames@univie.ac.at (B. Sames).