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Reconstruction of Interregional Late Cretaceous Sea-Level Record Using Integrated Benthic Foraminiferal Biofacies and Nannofossil Biostratigraphy

Description of proposed research

My project will establish global correlation of Upper Cretaceous (Cenomanian-Campanian) depositional sequences between the eastern US Gulf and New Jersey coastal plains and Russian Platform regions. High resolution biostratigraphy of calcareous nannoplankton, and planktonic foraminifera will be applied for interregional correlation. The results will contribute to global estimates of sea-level changes and to interregional a biostratigraphic and sequence stratigraphic reconstructions of Cenomanian-Campanian strata.

Biostratigraphy is a powerful tool in many different areas of stratigraphic reconstructions. Microbiostratigraphy is an indispensable tool for a variety of stratigraphic work in many different regions for both academic and the oil exploration industry. My studies have focused on the application of microbiostratigraphy to Late Cretaceous sea-level reconstructions in the northern part of Atlantic passive margin -New Jersey coastal plain. My approach has been to integrate sequence stratigraphy, paleobathymetry and biostratigraphy to derive a record of Late Cretaceous sea-level changes in the New Jersey coastal plain and establish firm biostratigraphy for interregional reconstructions. I conducted nannofossils biostratigraphy for age control; used benthic foraminiferal assemblages for paleobathymetry estimates; and applied integrated sequence stratigraphic analysis on the basis of physical stratigraphy, lithofacies analysis and geochronology. My studies provide high-resolution (<1myr) integrated stratigraphic record on New Jersey coastal plain that indicates large and rapid global sea-level variations occurred in the Late Cretaceous (Fig. 1.2, Mizintseva et al., submitted).

The estimates of timing and amplitudes of geologic mechanisms producing eustasy indicate that only glacioeustasy operates on less then 1myr scale with up to 100 m amplitude (Pitman and Golovchenko, 1983; Fig. 3). In this case, the only mechanism that can explain large and rapid global sea-level changes of the Late Cretaceous is formation of continental ice sheets during sea-level falls.

The verification of triggering mechanism for the sea-level falls during Cenomanian-Turonian and Santonian – early Campanian requires high-resolution (<1myr) global sea-level record. While, New Jersey coastal plain studies have obtained sea-level records with resolution less 1myr, it limited to one location and required verification with other globally distributed localities.
Here, I propose to build global sea-level record for two warmest episodes in Late Cretaceous (the Cenomanian-Turonian and Santonian – early Campanian) on my previous work in New Jersey.

I evaluated several geographical locations and conclude that the eastern US Gulf region provide the resolution of Upper Cretaceous stratigraphic record similar to that of New Jersey and the same high-resolution record can be potentially obtained on the Russian Platform.

Upper Cretaceous strata of the eastern US Gulf coastal plain contain a relatively complete section of marine to nonmarine mixed siliciclastic and carbonate sediments (Mancini et al, 1994). The marine lithofacies are rich in calcareous nannoplankton and planktonic foraminifera that have been used for biostratigraphic zonation. Depositional sequences are identified on the basis of the litho-and sequence stratigraphy (Mancini et al, 1996, 2005). Maximum flooding surfaces of these depositional sequences are considered as chronostratigraphic horizons, and are used for regional correlation. The sequence boundaries, however, are diachronous and require further verification (Mancini et al, 1996). Correlation with high-resolution sea-level record from New Jersey can verify timing and duration of the sequence boundaries from the Gulf coastal plain.
The Late Cretaceous sections of the Russian Platform provide excellent records of transgressive-regressive sequences (Sahagian et al., 1996). The Russian platform is a

tectonically quiet region with extensive Upper Cretaceous deposits. Previous study of Sahagian et al., (1996) indicates remarkably close correlation between low-resolution sea-level records from the Russian platform and the sea-level record from New Jersey. For my studies with less than 1myr resolution, the Russian platform sea-level record required increased resolution of biostratigraphy and paleobathymetry estimates.
The objectives of my work are to refine biostratigraphy, paleobathymetry, and sequence stratigraphy of the Upper Cretaceous units of the Russian platform and the eastern US Gulf coastal plain and provide an integrated correlation between the New Jersey coastal plain and those regions. My approach is: 1) date unconformity bounded units with nannofossils and foraminifera biostratigraphy; 2) use benthic foraminifer as supplemented by lithofacies studies to reconstruct water depth changes; 3) establish interregional correlation of the sequences by use of foraminifera and nannofossils biostratigraphy; 4) estimate Late Cretaceous sea-level changes on a global scale.

Methods:

My proposed area of studies is the Russian Platform sections near Moscow originally studied by Sahagian et al. (1996; Fig. 4). The samples will be taken from five wells and two outcrops in the Moscow region. The wells are Teplyi Stan (M1), Vorokhobino (M9), Yuriev-Polskii (M47), Savelievo (M 163), Varanino (M456) and the outcrops are at Yangoda and Agapa Rivers (Fig. 4; Sahagian et al., 1996). For my study, I will go for one week field work in Russia, resample outcrop and well sections, and conduct nannofossils biostratigraphy and benthic foraminiferal paleobathymetry analyses. Using obtained data I will correlate the Upper Cretaceous strata of the Russian Platform, New Jersey coastal plain and the eastern US Gulf coastal plain on the basis of foraminifera and nannofossils biostratigraphy. The data of sequence stratigraphic and biostratigraphy analyses of the Gulf Coast have been published by Mancini et al. (1996). For sequence stratigraphy of this region and interregional correlation I will use published data of Mancini et al. (1994 and 1996).

Expected results and Future work:

I expect to increase the biostratigraphic and paeobathymetric resolution of the Russian Platform region and provide verification of sequence stratigraphic analysis in the eastern US Gulf coastal plain. My studies will provide a firm biostratigraphic age control and sea-level estimates on a global scale for Upper Cretaceous strata.
In my future work, on my Ph.D project "Broken windows in the Greenhouse: Testing Late Cretaceous glacioeustasy" , I will provide close correlation between global sea-level and deep-sea oxygen isotope records. Detection of synchronous changes in eustasy and $\delta^{18}O$ will evident for presence of intermittent ice sheets during the Late Cretaceous sea-level falls. I envision contribution of my project to scientific community and as well as industrial geology.

References:

Mancini, Ernest A., and Puckett, T. Markham, 2005, Jurassic and Cretaceous transgressive-regressive (T-R) cycles, northern Gulf of Mexico, USA: Stratigraphy, v. 2, no. 1, p. 30-47.

Mancini, E. A., Puckett, T. M., and Tew, B. H., 1996 Integrated biostratigraphic and sequence stratigraphic framework for Upper Cretaceous strata of the eastern Gulf Coastal Plain, USA, Cretaceous Research 17:645-669.

Mancini, E.A., And Tew, B.H., 1994 Integrated biostratigraphic and sequence stratigraphic approach for intrabasin and interbasin correlations: Upper Cretaceous and Paleogene strata of the eastern Gulf Coastal Plain, USA, in Application of Sequence Stratigraphy to Oil Field Development, AAPG Hedberg Research Conference, p. M1-M5.

Miller, K.G., Sugarman, P. J., Browning, J. V., Kominz, M. A., Olsson, R. K., Feigenson, M. D. And Hern‡ndez, J. C., 2004. Late Cretaceous sequences and sea-level history, New Jersey coastal plain. Geological Society of America Bulletin, 116: 368-393.

Mizintseva, S, Browning, Miller, K, Olsson, R (Submitted) Integrated Late Santonian-Early Campanian Sequence Stratigraphy, New Jersey coastal plain: implications to global sea-level studies, Stratigraphy

Pitman, W. C., Iii, And Golovchenko, X., 1983. The effect of sea-level change on the shelf edge and slope of passive margins. In: Stanley, D. J. and Moore, G. T., Eds., The Shelfbreak: critical interface on continental margins, 41–58. The Society of Economic Paleontologists and Mineralogists, Special Publication 33

Sahagian, D., Pinous, O., Olferiev, A., Zakaharov, V., and Beisel, A., 1996, Eustatic curve for the Middle Jurassic-Cretaceous based on Russian platform and Siberian stratigraphy: Zonal resolution, American Association of Petroleum Geology Bulletin, v. 80, p. 1433-1458.

SHORT BIOGRAPHY

I started my career in geology at Moscow State University Geological School. There Iobtained a Master Degree in oil and gas geology in1995. In1998 I moved to the United States, and got enrolled in graduate school of Rutgers University in 2002. In 2006 I obtained a Master Degree on sea-level changes in the Late Cretaceous, supervised by Dr. Kenneth G. Miller. Now I am continuing to work on the Late Cretaceous stratigraphicrecords of New Jersey coastal plain and extend these record on the global scale.

RESEARCH INTERESTS

PhD Project: **"**Broken windows in the Greenhouse: Testing Late Cretaceous glacioeustasy."

- Test an innovative hypothesis that continental ice sheets started to accumulate around 90 Ma ago, despite a global climate that was hot and humid.
- Specific studies involving sequence stratigraphy, biostratigraphy, isotope geochemistry, sea-level reconstructions, paleobathymetry.
- The results will broaden our understanding of sea level responses to extremes in climate conditions such as global warming.

EDUCATION

2006 MS, *Specialization*: Stratigraphy, Rutgers University. Thesis Topic: Deposition and paleowater depth changes during the late Santonian-early Campanian (77-86 MA) on the New Jersey coastal plain".

2002 Certified program in Proficiency in American Language Studies. Rutgers University.

1995 MS, *Specialization*: Petroleum Geology, Moscow State University, Russia.

SKILLS

- Instruction, teaching-assistance, laboratory and research experience
- Research assistant on the drill sites

DRILL SITES RESEARCH ASSISTANT
2002 Millville, NJ
2003 Sea Girt, NJ
2005 Chesapeake Bay, VA,
2007 Medford, NJ

TEACHING
2005-2006 Introductory Geology (100)
2006-2008 Stratigraphy (400)
2007 Sedimentary geology (400)

PUBLICATIONS
Mizintseva, S.F., Browning, J.V., Miller, K.G., Integrated late Santonian-early Campanian sequence stratigraphy, New Jersey coastal plain: implications to global sea-level studies. - *Submitted to* Stratigraphy

Mizintseva, S.F., Browning, J. V., Miller, K. G., Integrated biostratigraphy, paleobathymetry, and sequence stratigraphy of late Santonian - early Campanian sequences on New Jersey Coastal Plain: implication to global sea-level: *abstract submitted to* GSA 2007

Miller, K.G, Wright, J.D., Katz, M.E., Browning J.V., Cramer, B.S., Wade B.S., Mizintseva, S.F. (2007) A view of Antarctic glaciation from sea-level and deep-sea isotope changes. - Proceeding of the International Symposium on Antarctic Earth Sciences, National Academy of Sciences Press.

Kominz, M., Browning, J.V., Miller, K.G., Sugarman, P.J., Mizintseva, S., and Scotese, C.R., (2008) Late Cretaceous to Miocene Sea-level Estimates from the New Jersey and Delaware Coastal Plain Coreholes: An Error Analysis. - Basin Research.

Mizintseva, S.F., Miller, K.G., Browning, J.V. (2006) Paleowater depth change and deposition during the late Santonian – early Campanian (77-83.5 Ma) on the New Jersey Coastal Plain: *abstract* to GSA

MEMBERSHIP, REWARDS & INTERNSHIPS
Member of Geological Society of America
Member of American Association of petroleum geologist
North American Micropaleontology Section of SEPM
2002-2006 Rutgers University Graduate School Fellowship
2004 NSF CHRONOS internship

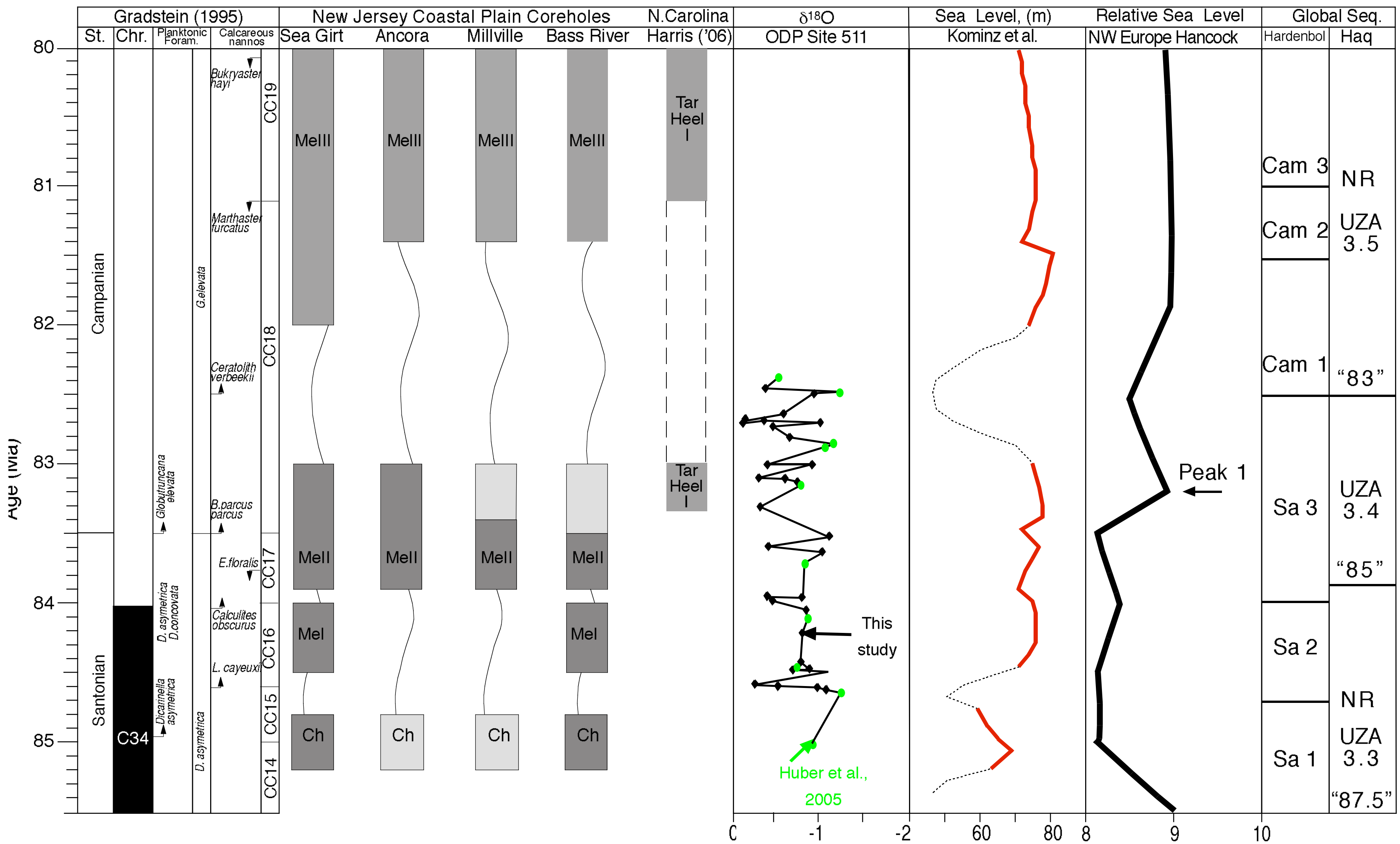


Fig. 1 Comparison of New Jersey coastal plain Merchantville sequences (Merchantville I = MeI, Merchantville II = MeII, Merchantville III = MeIII) with Tar Heel I sequence of southern North Carolina (Harris et al., 2006), deep-sea benthic foraminiferal δ18O from ODP Site 511 (Huber et al., 2002- circles, current studies-diamonds); sea-level estimate of Kominz et al., (in review); from backstripping of New Jersey coastal plain paleobathymetry estimates, relative sea-level estimates of Hancock et al., 1993 (Northwestern Europe), and global sequence boundaries of Hardenbol et al. (1998) and Haq et al. (1987; ages in quotes). Time scale of Gradstein (1995). (Con. – Coniacian, Broin. - Broinsonia, E. floralis – Eprolithus floralis, L. cayeuxi - Lucianorhabdus cayeuxi).

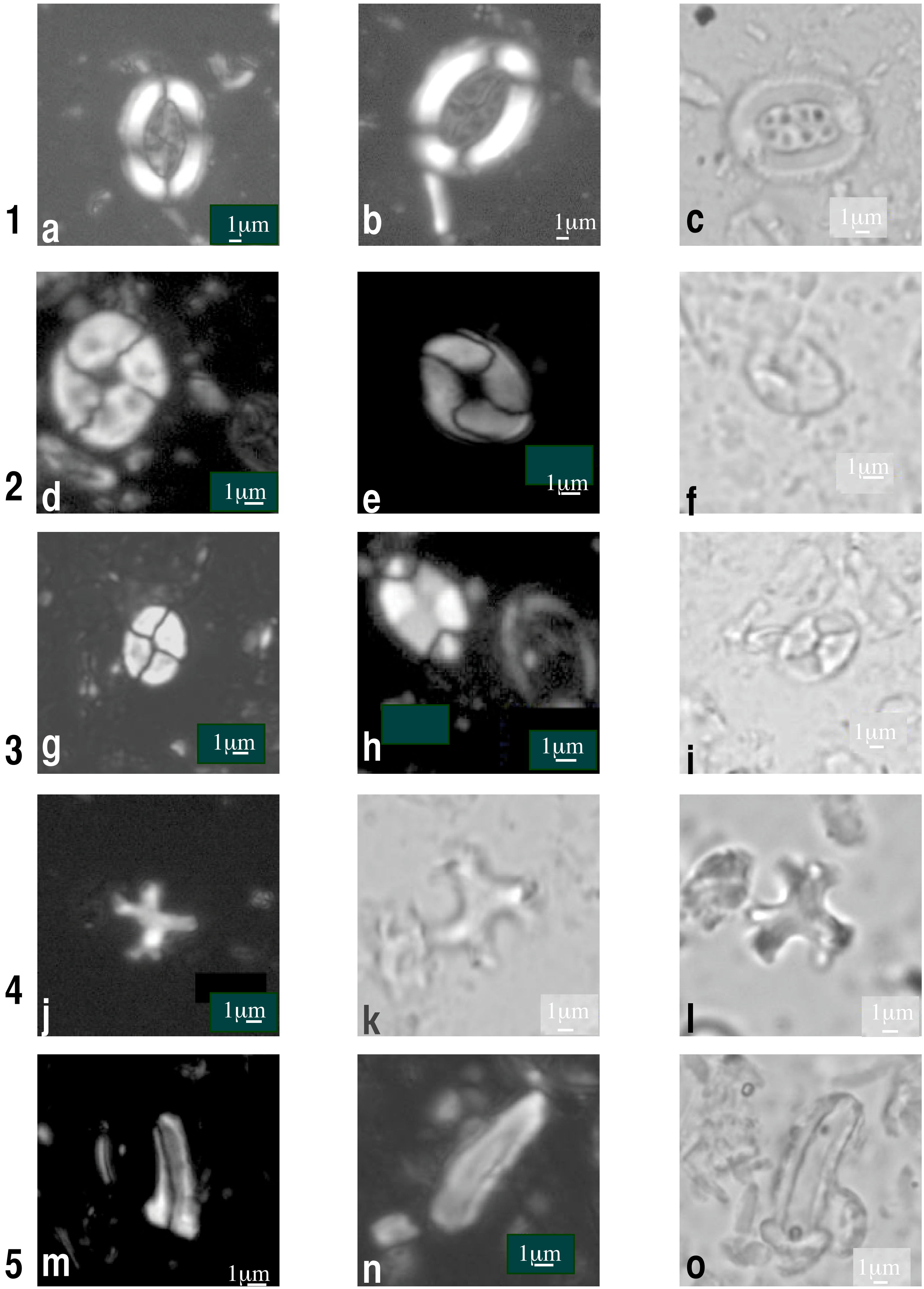
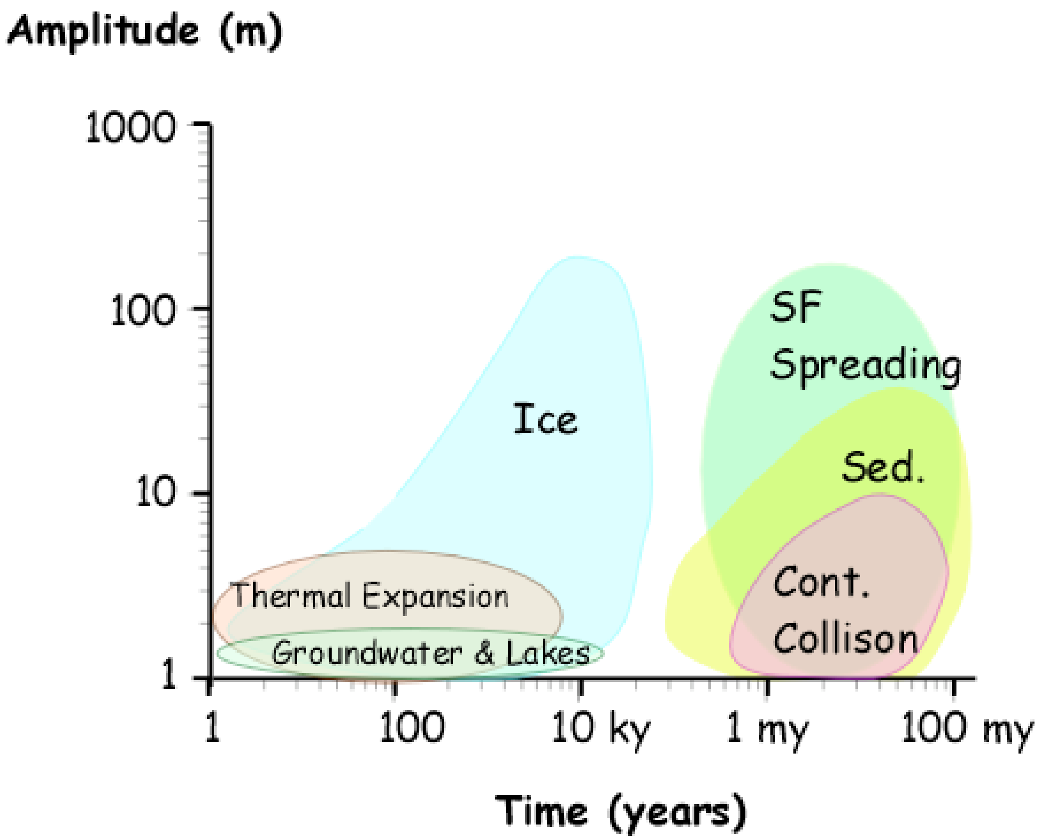
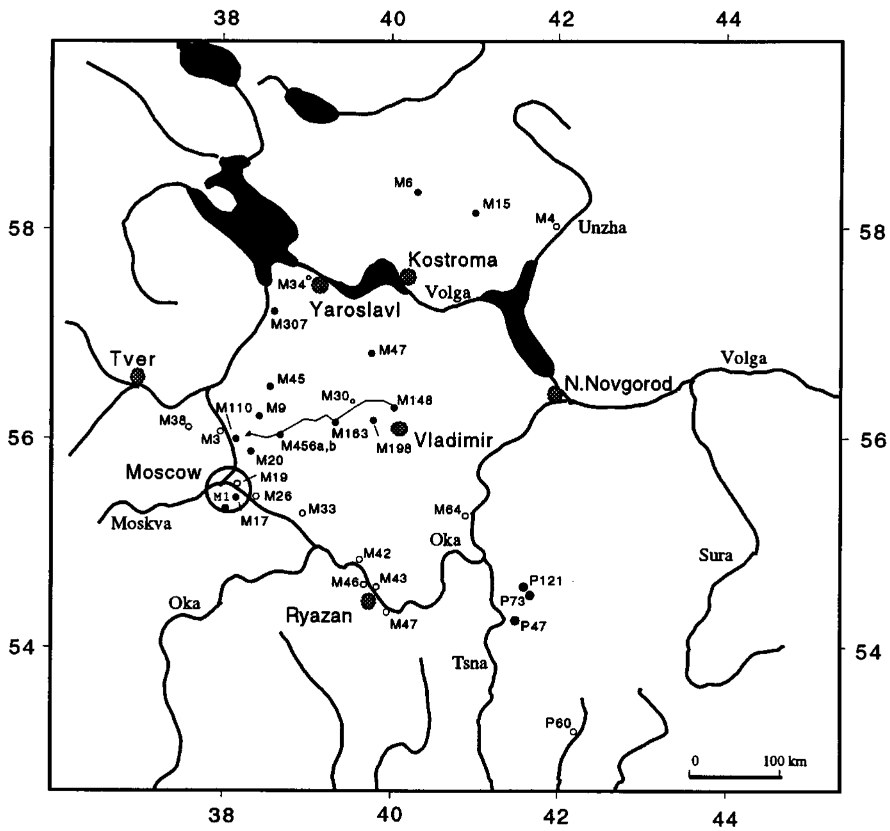


Fig.2 Calcareous nannofossils speciments from the Millville corehole of New Jersey coastal plain.



Timing and amplitudes of geologic mechanisms of eustatic change derived from Miller et al., (2005)



• wells ∘ outcrops cross section

M1 - Teplyi Stan	M43 - Novoselki
M3 - Volgusha	M45 - Skovorodino
M4 - B. Korovitsa (Unzha)	M46 - Kuzminskoe
M6 - Yurino	M47 - Yuriev-Polskii
M9 - Vorokhobino	M64 - Elatma
M15 - Galich	M110 - Paramonovo
M17 - Kolomenskaya	M148 - Shikhobolovo
M19 - Khodynka	M163 - Savelievo
M20 - Tsernskoe	M198 - Boristsevo
M26 - Kotelniki	M307 - Uglich
M30 - Eza	M456 - Varavino
M33 - Lopatino	P47 - Prosandeevka
M34 - Krest	P60 - Vorona
M38 - Gavrilkovo	P73 - Lasitskyi ovrag
M42- Alpatievo	P121 - Lasitsy

Fig. 3 Locations of the main wells and outcrops in Moscow Region
used for the construction of the quantified eustatic curve (After Sahegian et al., 1996).

Figure Captions

Fig. 1 Comparison of New Jersey coastal plain Merchantville sequences (Merchantville I = MeI, Merchantville II = MeII, Merchantville III = MeIII) with Tar Heel I sequence of southern North Carolina (Harris et al., 2006), deep-sea benthic foraminiferal _18_from ODP Site 511 (Huber et al., 2002-circles, current studies-diamonds); sea-level estimate of Kominz et al., (in review); from backstripping of New Jersey coastal plain paleobathymetry estimates, relative sea-level estimates of Hancock et al., 1993 (Northwestern Europe), and global sequence boundaries of Hardenbol et al. (1998) and Haq et al. (1987; ages in quotes). Time scale of Gradstein (1995). (Con. – Coniacian, Broin. -Broinsonia, E. floralis – Eprolithus floralis, L. cayeuxi -Lucianorhabdus cayeuxi).

Fig.2 Explanation of calcareous nannofossils plate All figured speciments are from the Millville corehole of New Jersey coastal plain. The depth refers to the sample from which the figured speciment was taken. All speciment names are given after Sissingh (1978) and Perch-Nielsen (1985). a. Lucianorhabdus cayeuxii, 1251 ft (381.3 m); b. Marthasterites furcatus, 1221 ft (372.1 m); c. Calculites ovalis, 1236 ft (376.7 m); d. Broinsonia parca parca, 1228 ft (374.2 m); e. Calculites obscurus, 1251 ft (381.3 m); f. Calculites obscurus, 1251 ft (381.3 m).

Fig. 3 Timing and amplitudes of geologic mechanisms of eustatic change derived (After Miller et al., (2005).

Fig. 4 Locations of the main wells and outcrops in Moscow Region used for the construction of the quantified eustatic curve (After Sahegian et al., 1996).