Международная конференция в честь столетия со дня рождения профессора Владимира Витальевича Лонгинова «Литодинамика донной контактной зоны океана»

Москва 14-17 сентября 2009 г.

Перспективы радиометрического датирования как базового инструмента морской литодинамики современных морских осадков

Лаптев Геннадий и Войцехович Олег

Отдел радиационного мониторинга

Украинский научно-исследовательский гидрометеорологический институт

www.uhmi.org.ua

УкрНИГМИ

- 1855 – Киевская метеорологическая обсерватория
- 1952 – образование института
- 1987 – образование лаборатории после аварии на ЧАЭС
- 1995 – сотрудничество с МАГАТЭ
- 2005 – присоединение к сети IAEA ALMERA Network, проэкт TC UKR 9/023 Development of Radiation Monitoring System in Ukraine

Подразделения

- МЧС
- НАНУ
- Севастопольское отделение (СоГОИН)

Технические средства измерения

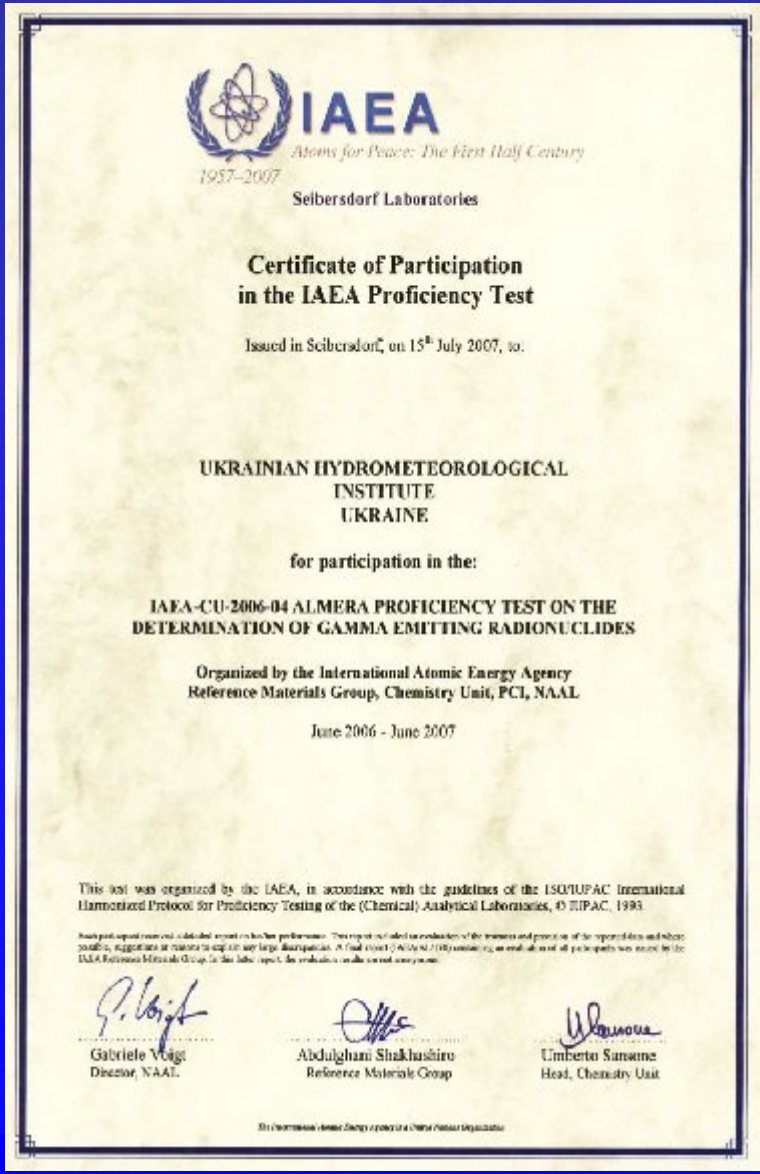
- HPGe Детекторы (GEM, GWL, GMX, BEGe)

  ^{238}U, ^{235}U, ^{234}Th, ^{226}Ra, ^{210}Pb, ^{228}Ra, ^{137}Cs
- NaI (in-situ)
- TriCarb 2900TR – ^{3}H, ^{14}C
- RUB01P – Gross Beta, ^{90}Sr
- 2 LSC Triathler (α/β separation)

  Gross Alpha , $^{238+234}U$, ^{226}Ra, ^{222}Rn, ^{210}Po, ^{90}Sr

Программа профессионального тестирования МАГАТЕ в сети ALMERA (с 2006)

гамма – 1-3 дня бета/альфа – 1 неделя



IAEA

Atoms for Peace: The First Half Century

1957–2007

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Organized by the International Atomic Energy Agency Reference Materials Group, Chemistry Unit, PCI, NAAL

June 2006 - June 2007

This test was organized by the IAEA, in accordance with the guidelines of the ISO/IUPAC International Harmonized Protocol for Proficiency Testing of the (Chemical) Analytical Laboratories, © IUPAC, 1993.

Gabriele Voigt, Director, NAAL | Abdulghani Shakhashiro, Reference Materials Group | Umberto Sansone, Head, Chemistry Unit

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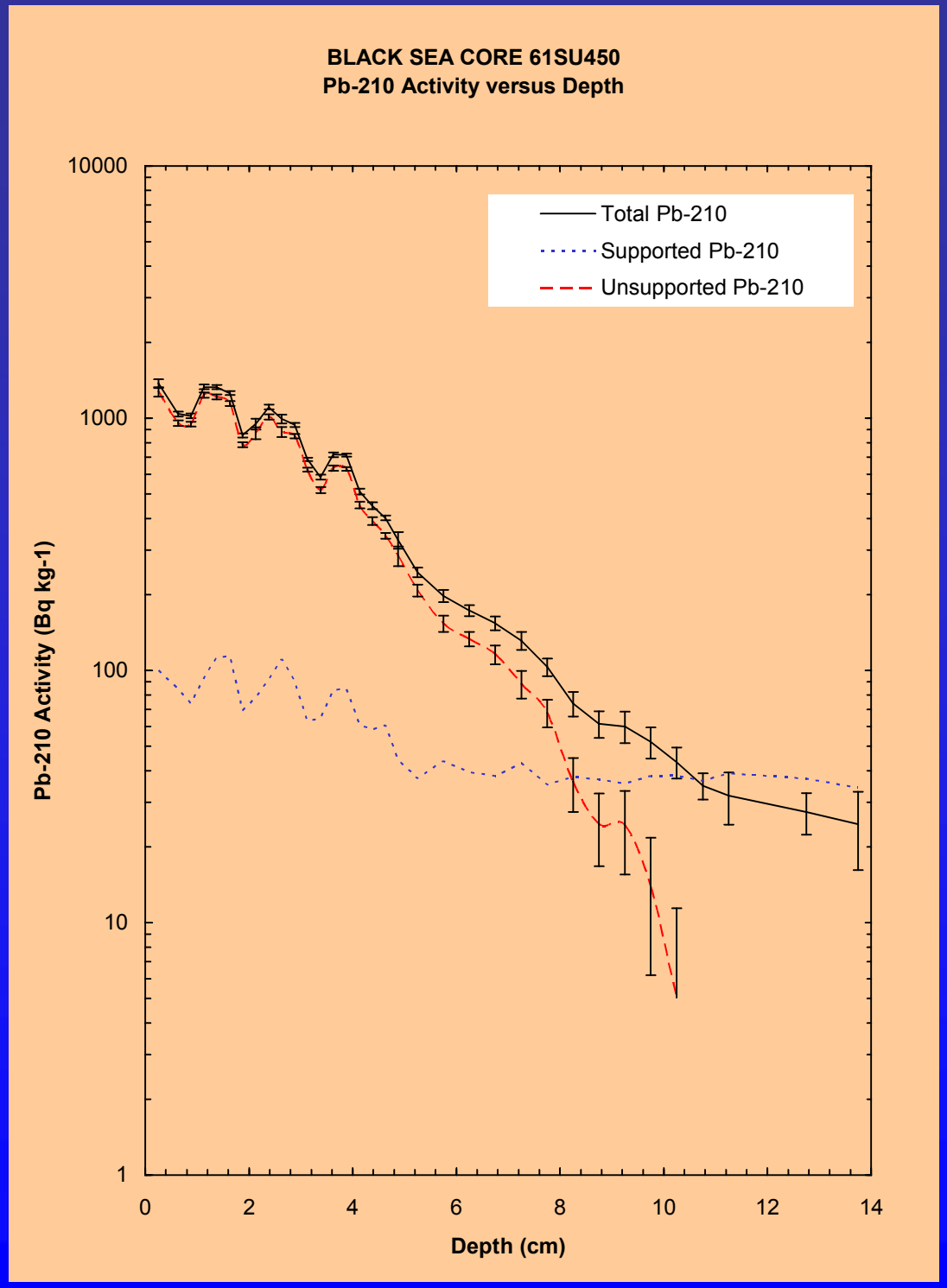
Gabriele Voigt, Director, NAAL | Abdulghani Shakhashiro, Reference Materials Group | Umberto Sansone, Head, Chemistry Unit

Radioisotope Sediment Study

- Sediment cores from abyssal (deep-sea) plain and continental slope collected during two international cruises in the framework of the IAEA Regional Technical Co-operation Project REP/2/003 “Marine Environmental Assessment in the Black Sea Region” (RADEUX-2000) and GEF “Black Sea Environment Recovery Project” (BSERP-2003) were subjected to detailed radiometric analysis.
- The sediment cores were collected using a MARK II-400 multi-corer (Bowers & Connelly) in both Western and Eastern subbasins of the Black Sea. The cores were sliced on board with a resolution of 0.2 – 0.4 cm for the top 5 cm and 1-5 cm downward using an extruder designed to preventing disintegration of the sediment structure.

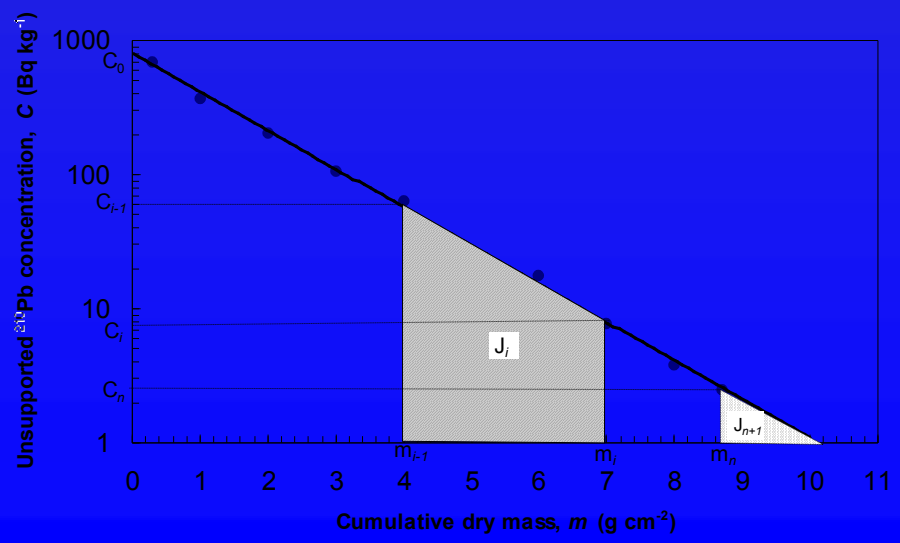


Basic Equations of the CRS ^{210}Pb dating model

$$A_x = A(0)e^{-\lambda t},$$

$$t = \frac{1}{\lambda}\ln\left[\frac{A(0)}{A_x}\right].$$

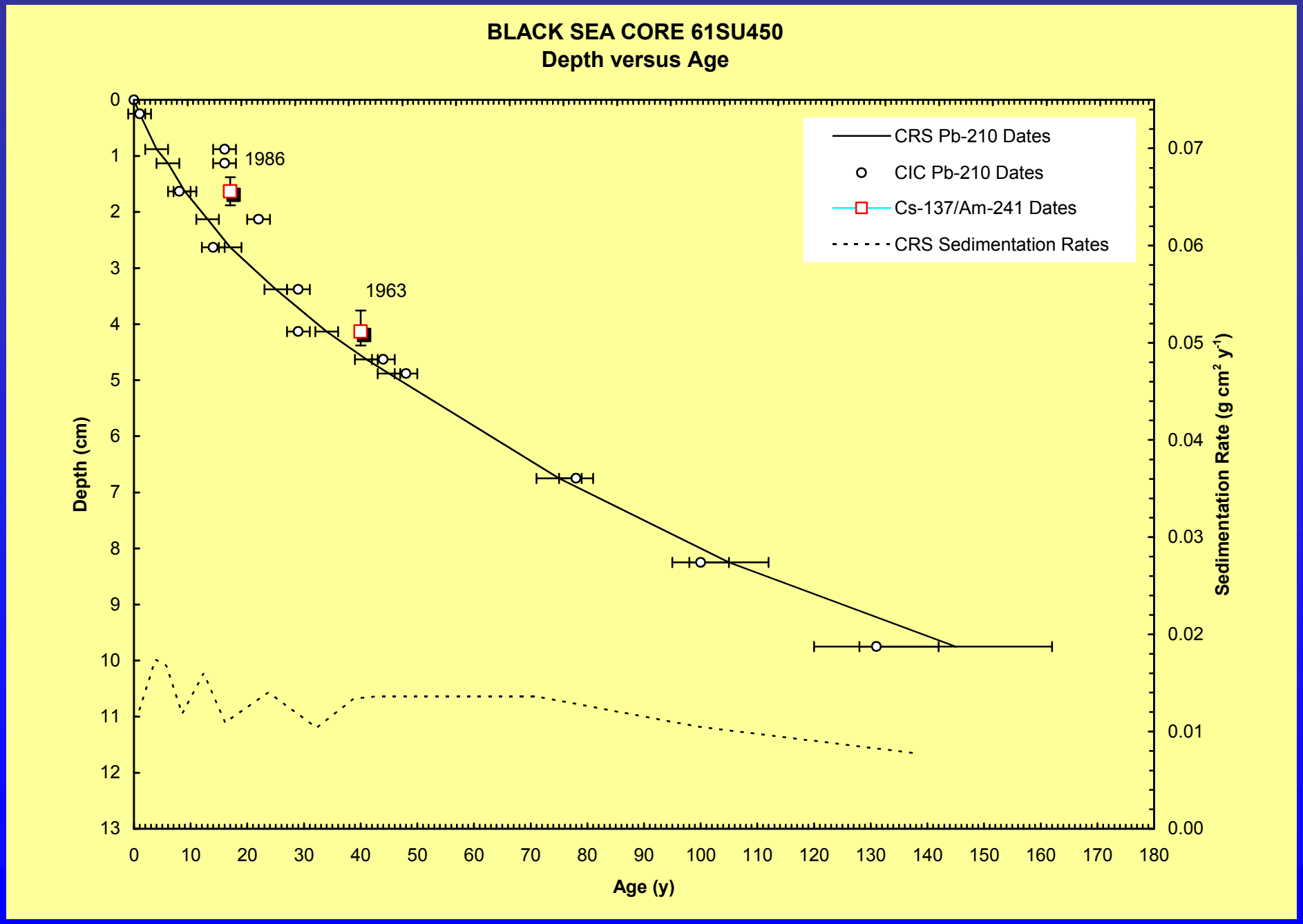
$$r = \frac{\lambda A_x}{C_x}, \quad A(0) = \frac{P}{\lambda}$$



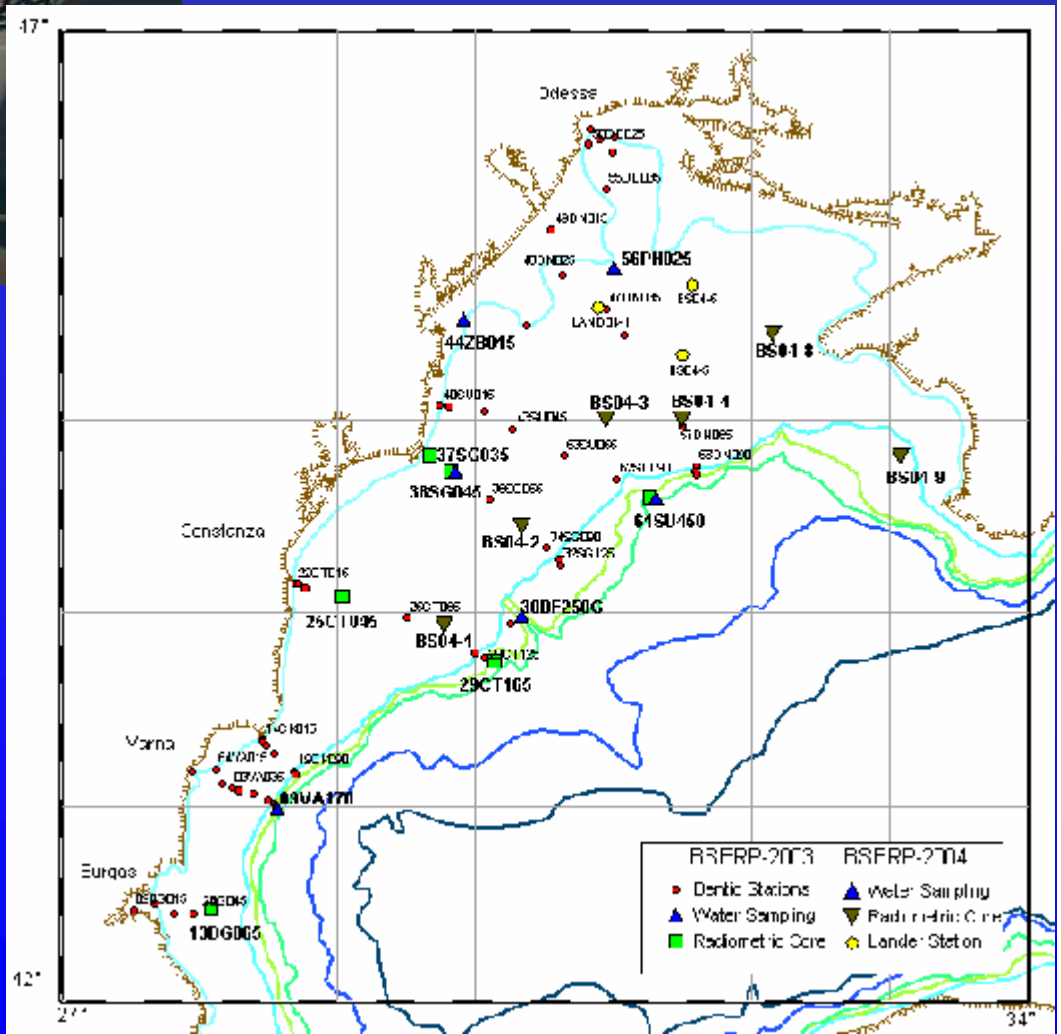
$^{210}Pb_{нр}$ Модели датирования

- CIC (Constant Initial Concentration) – *Goldberg, 1963 – Limited to Monotonic Decline of Pb-210 Activity*
- CRS (Constant Rate of Supply) – *Appleby&Oldfield, 1978 – Flux fixed, SedRate may vary*
- SIT (Sediment Isotope Tomography) – *Carroll, 1995 – Furrier Series Analysis, no mixing or migration*
- IMZ (Incomplete Mixing Zone) – *Abril, 1992 – Labile fraction of Radionuclide undergo rapid mixing*

Geochronological Dating Stratigraphy



Radioisotope Applications in Marine Research



The Black Sea Expeditions:

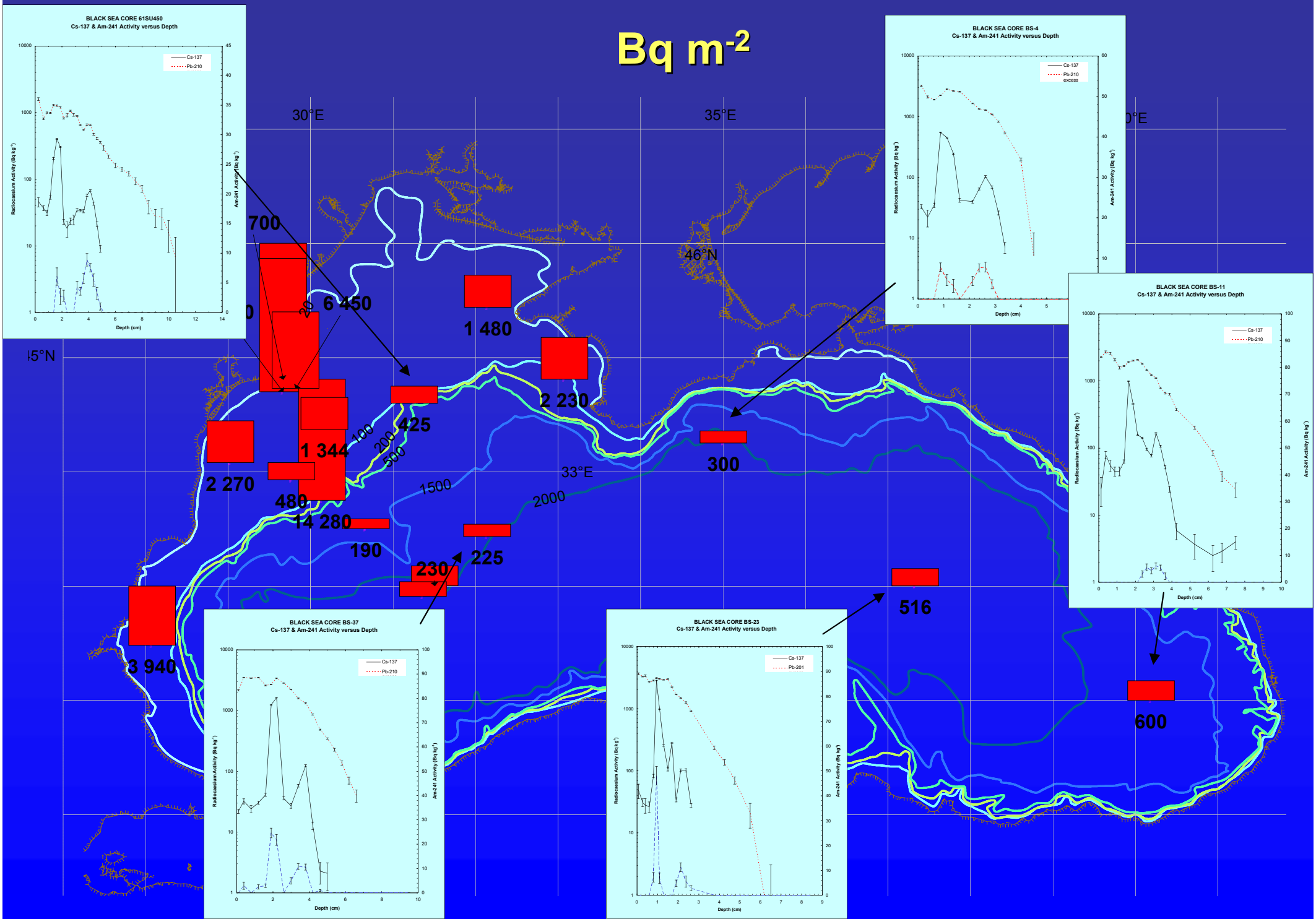
- **1998, 2000 – IAEA**
- **2003, 2004 and 2006 - GEF BSERP**

Caspian Sea:

2006 IAEA

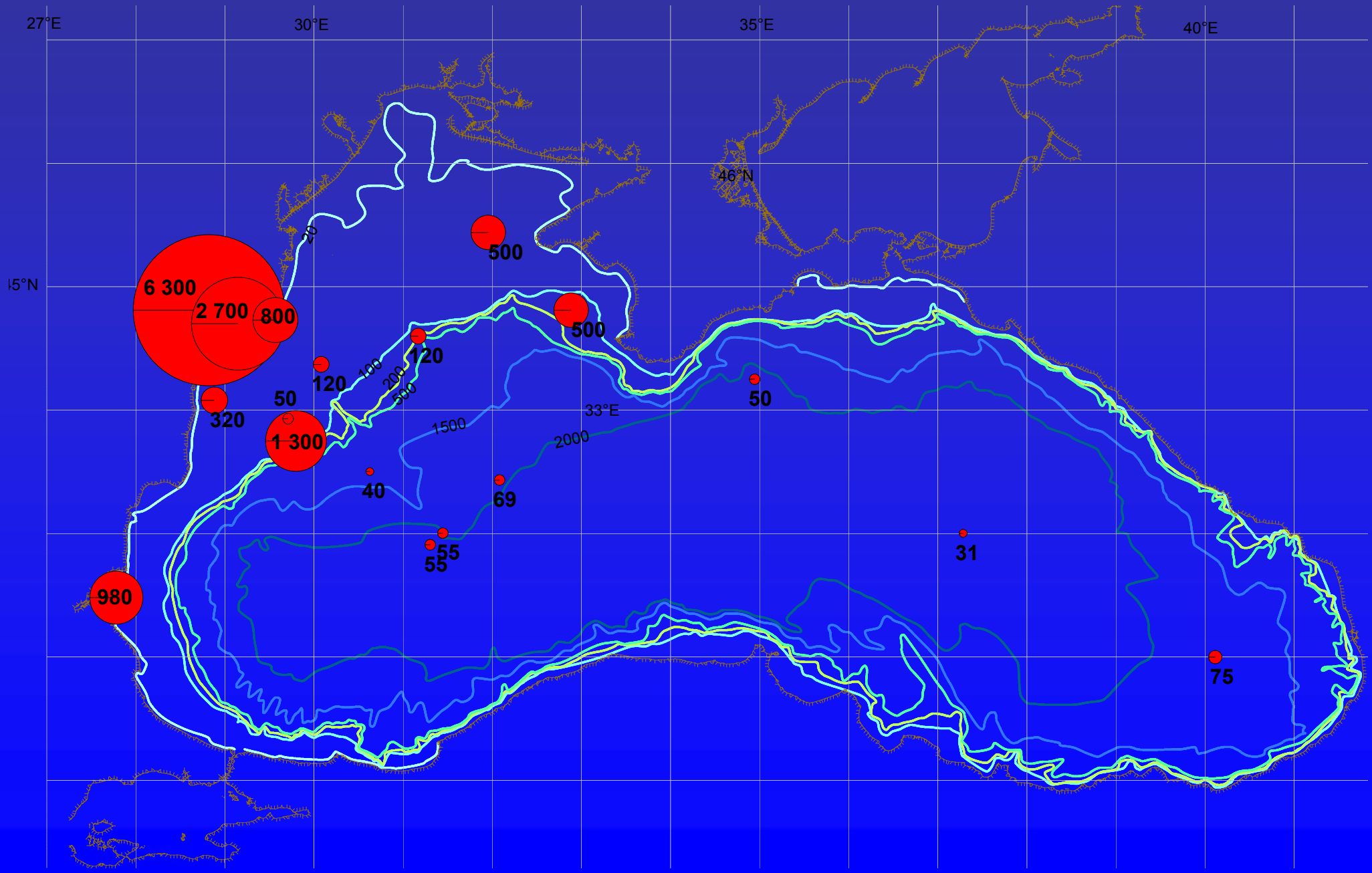
2008, 2009 - CEP

Cesium-137 in Bottom Sediment of the Black Sea, Bq m^{-2}



MAR in Bottom Sediment of the Black Sea,

g m^{-2} y^{-1}



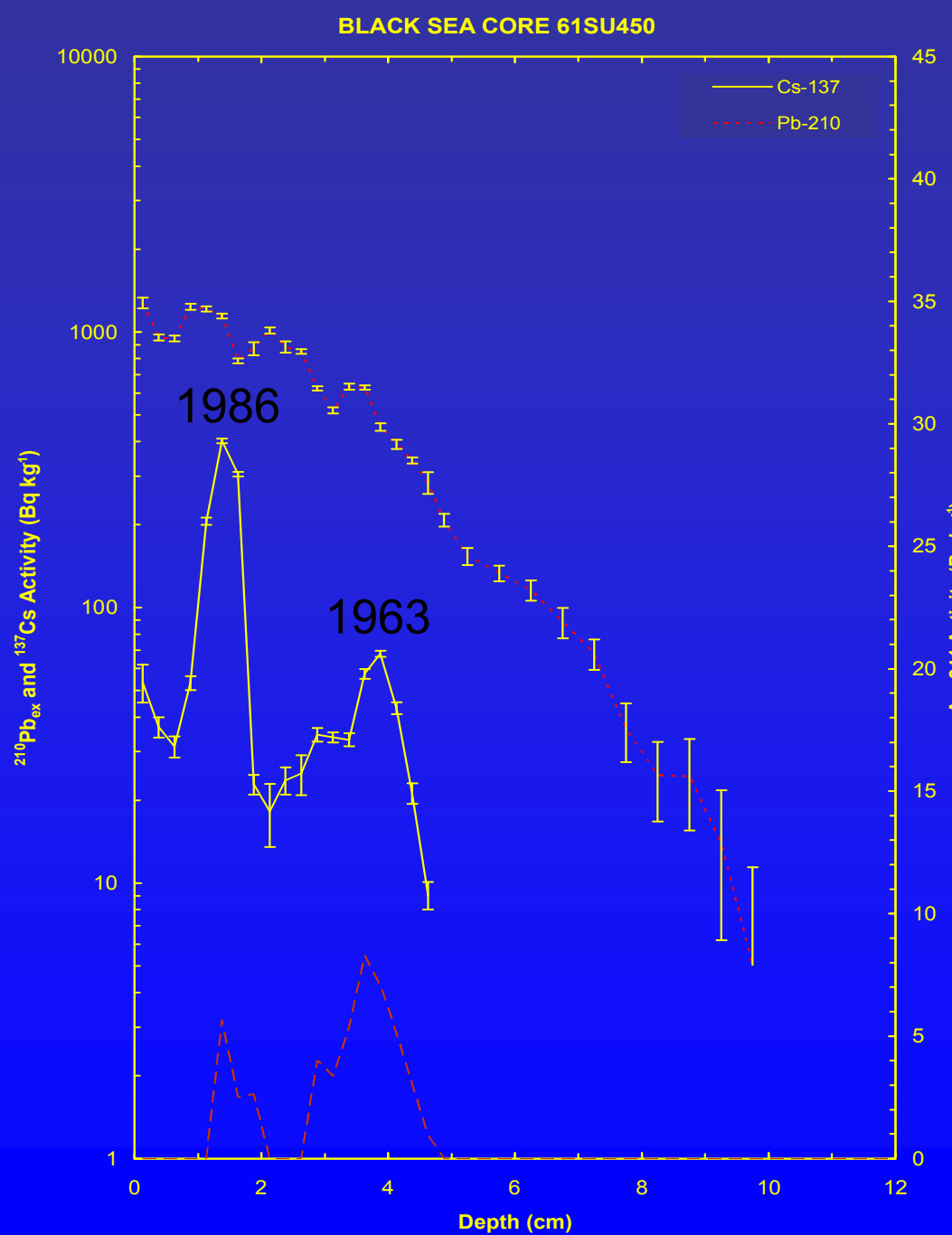
Sediment Core Sampling

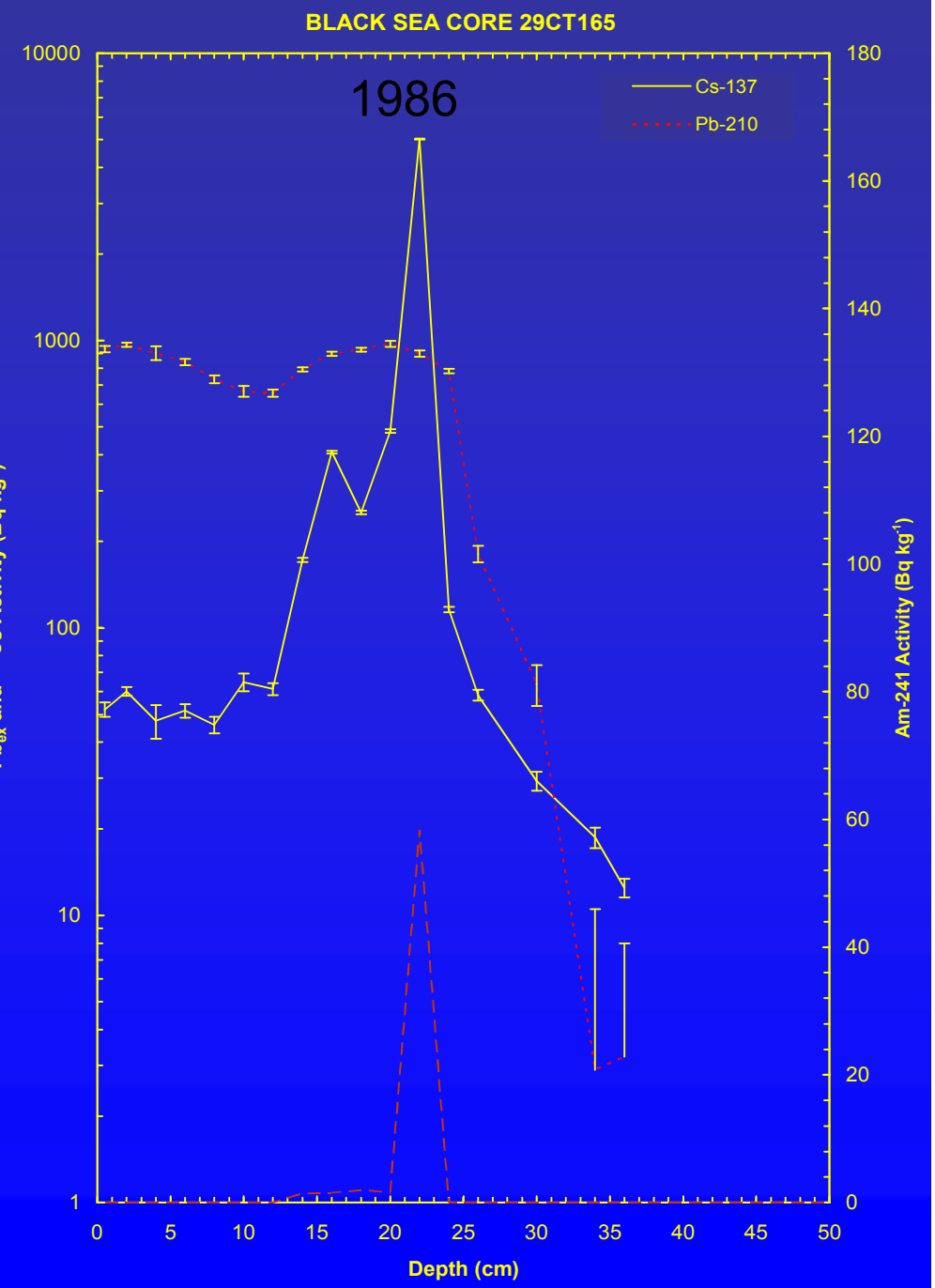
Sediment Core Processing

Sediment Core Processing

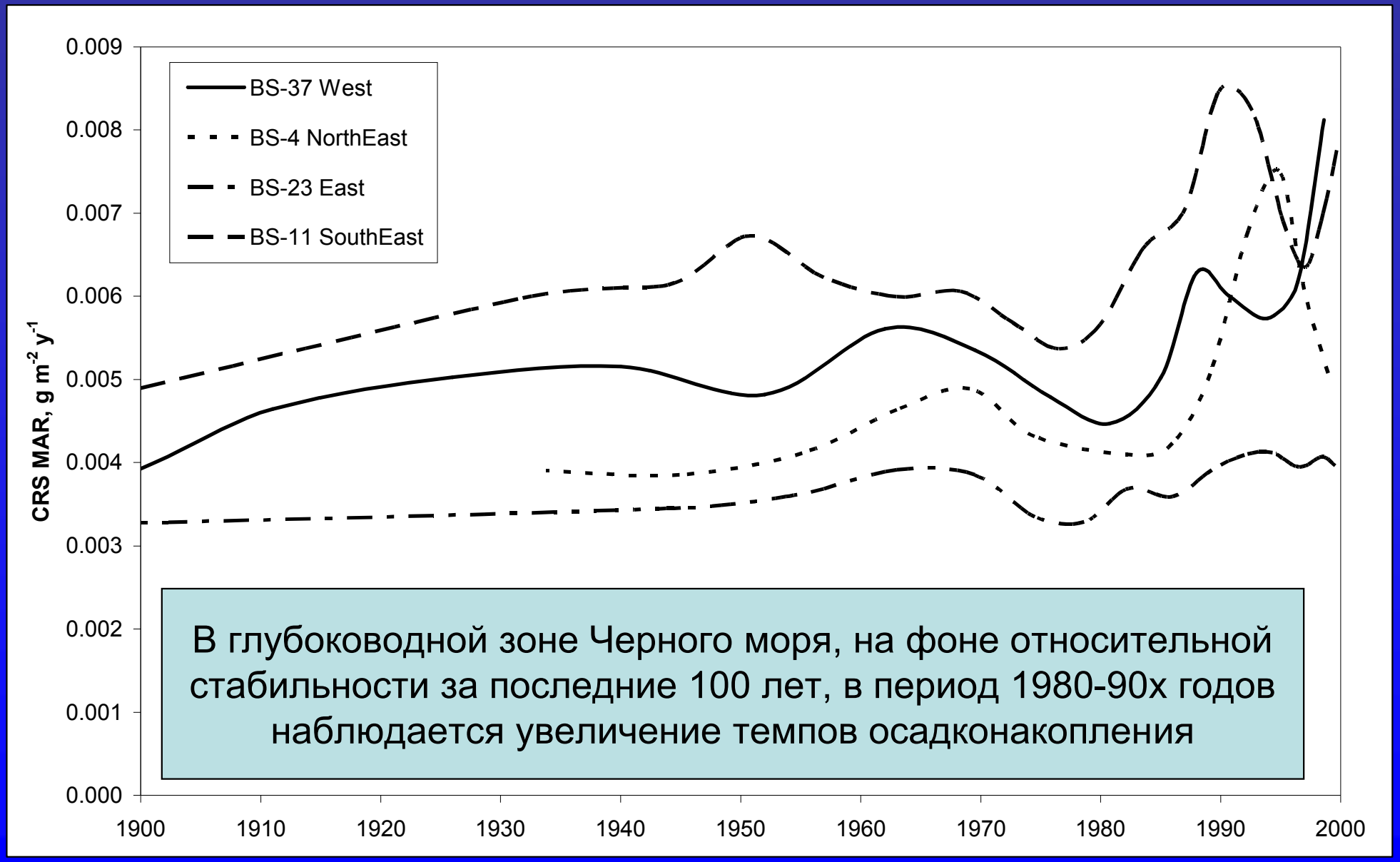
Laminated Sediment

$^{210}Pb_{ex}$, ^{137}Cs and ^{241}Am vs Depth



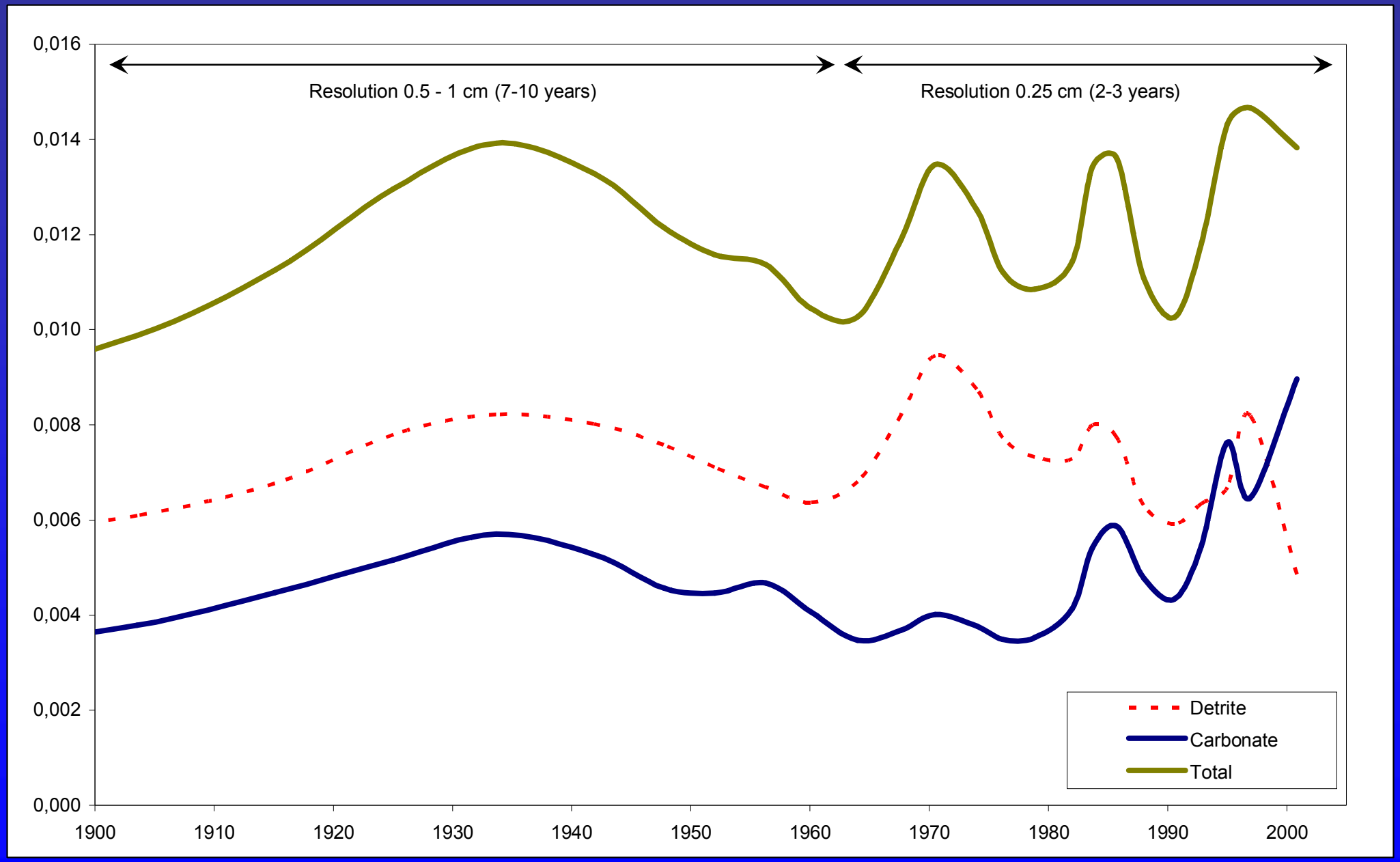


MAR Abyssal Sediment, Black Sea

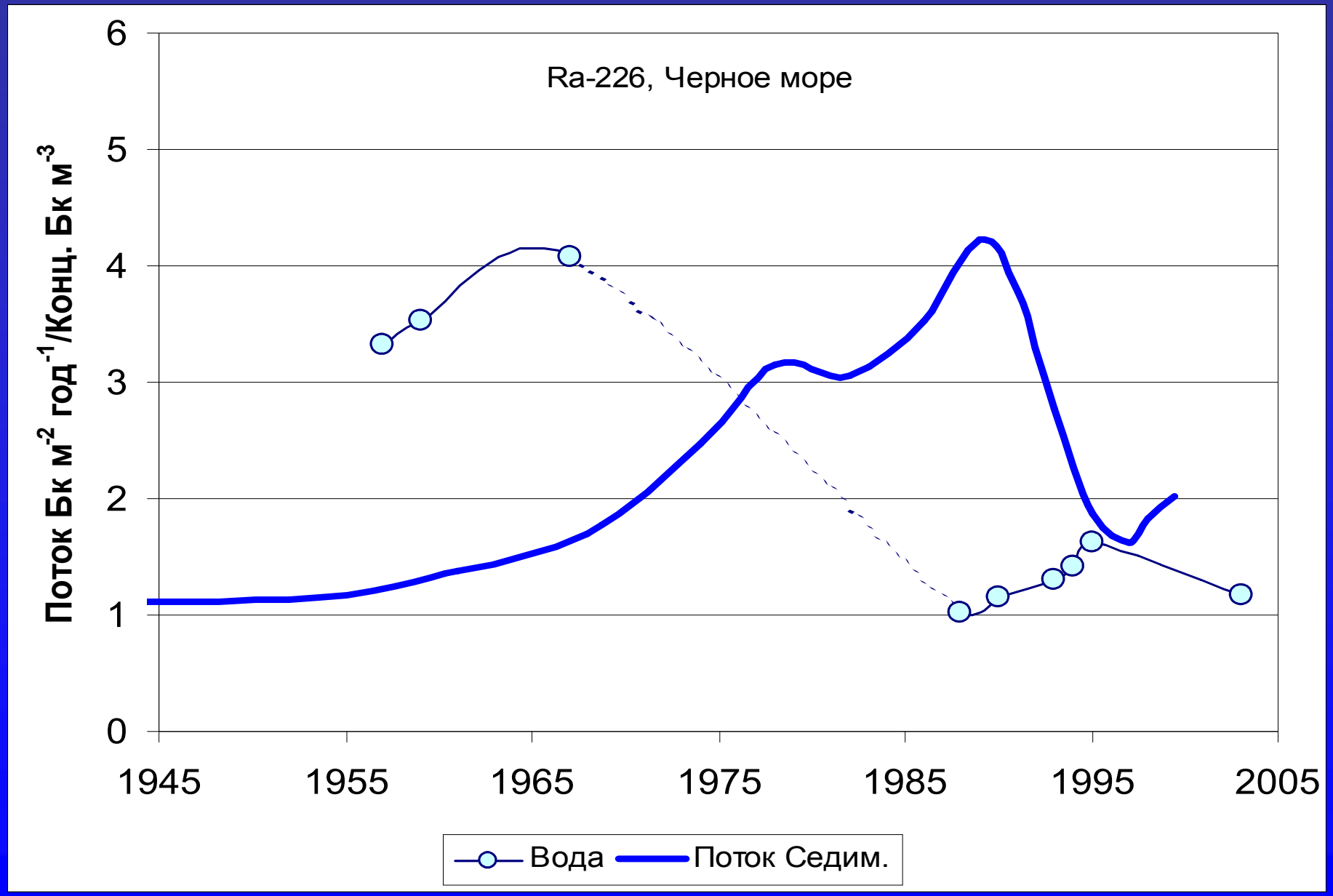


В глубоководной зоне Черного моря, на фоне относительной стабильности за последние 100 лет, в период 1980-90х годов наблюдается увеличение темпов осадконакопления

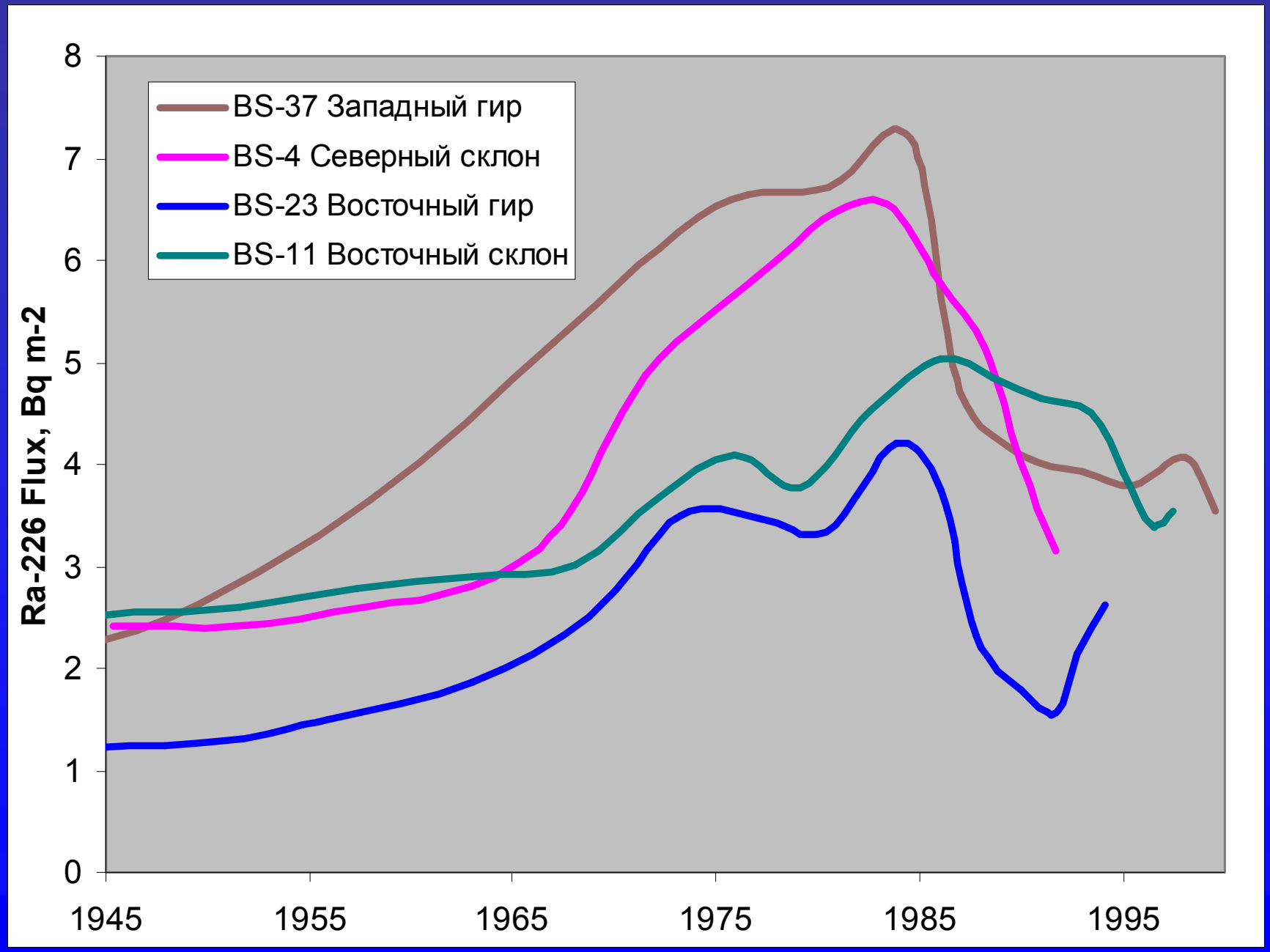
Mass Accumulation Rate, Core 61SU450 NW Slope



Нарушение равновесия радия – геохимический индикатор изменений климата в системе Черного моря?

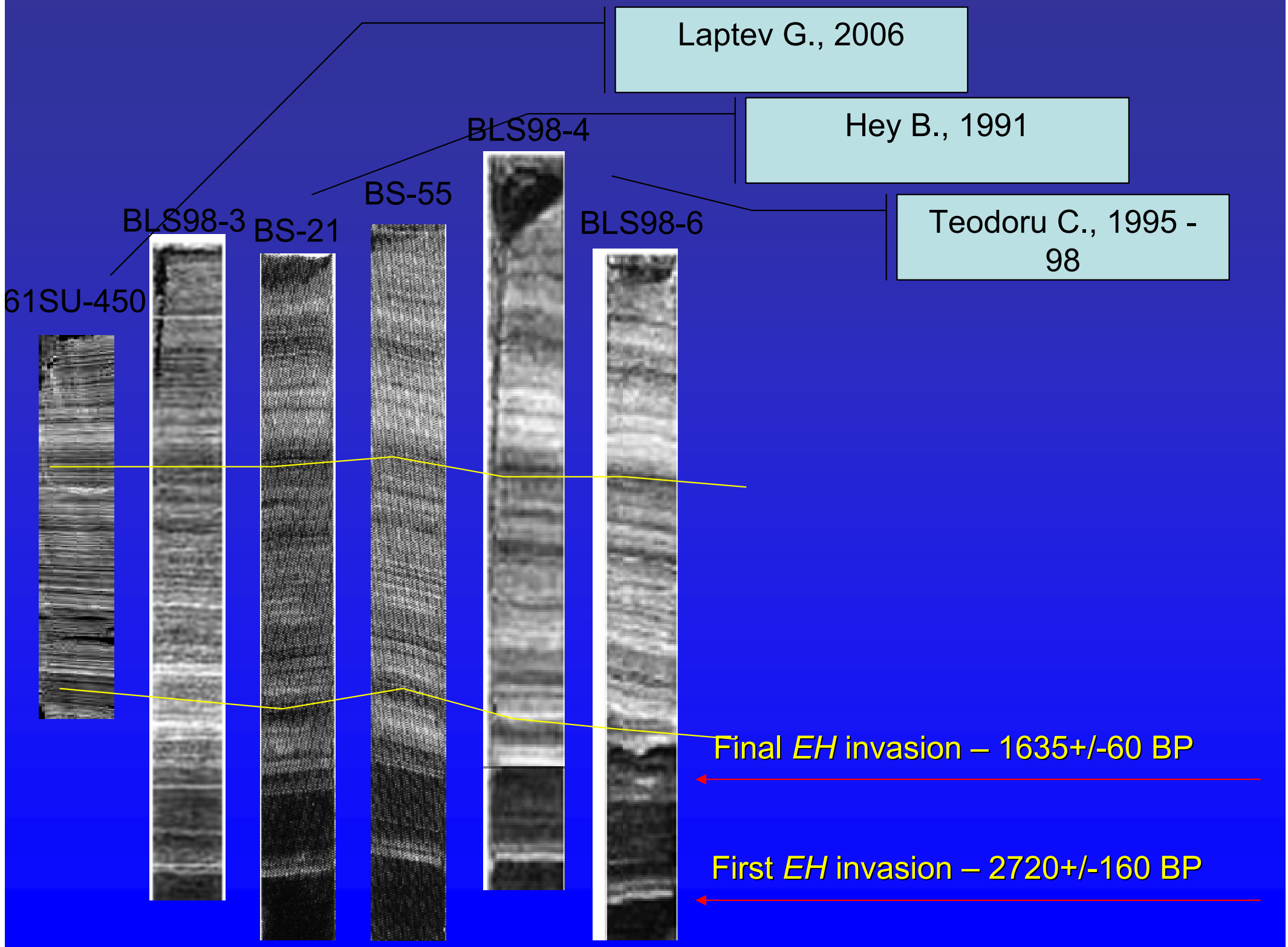


Поток Ra-226 в глубоководные осадки

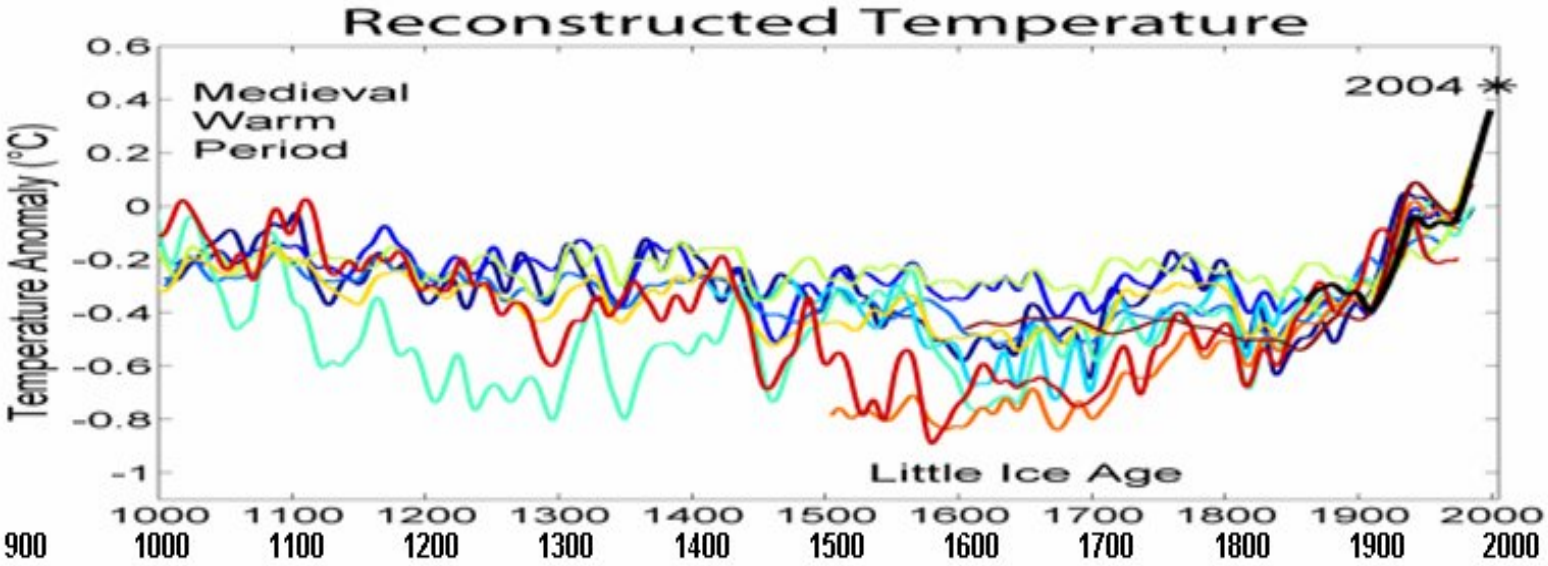


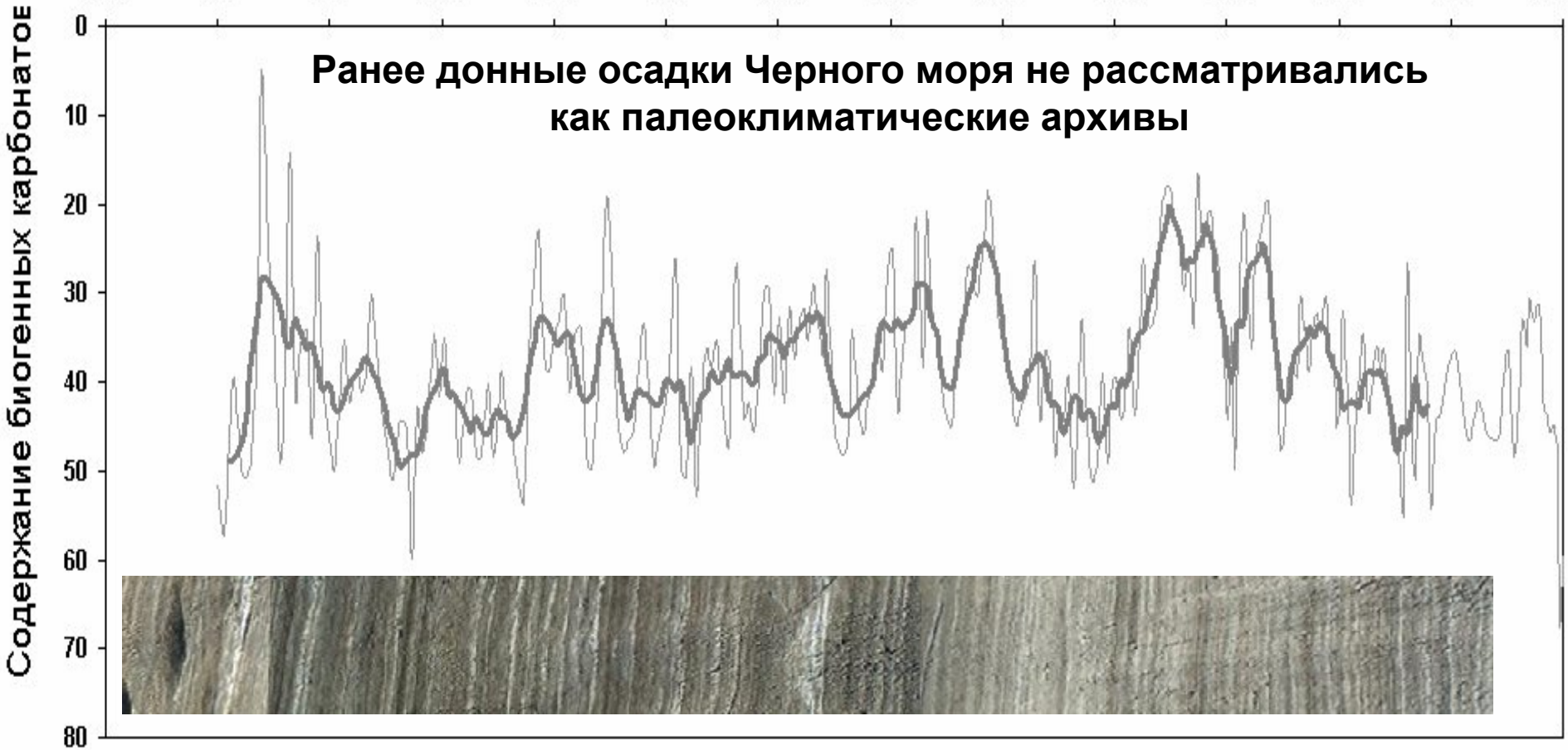
Микро-слоистые (ламинированные) донные осадки Черного моря, СЗ континентальный склон

Изменение темпов осаждения карбонатов может быть использовано в качестве прокси-показателя для (палео) реконструкции регионального климата за последние 2000 лет.
Для калибровки используются данные радиоизотопного датирования современных осадков (100-150 лет)


Laptev G., 2006
Hey B., 1991
Teodoru C., 1995 - 98
61SU-450
BLS98-3
BS-21
BS-55
BLS98-4
BLS98-6
Final *EH* invasion – 1635+/-60 BP
First *EH* invasion – 2720+/-160 BP

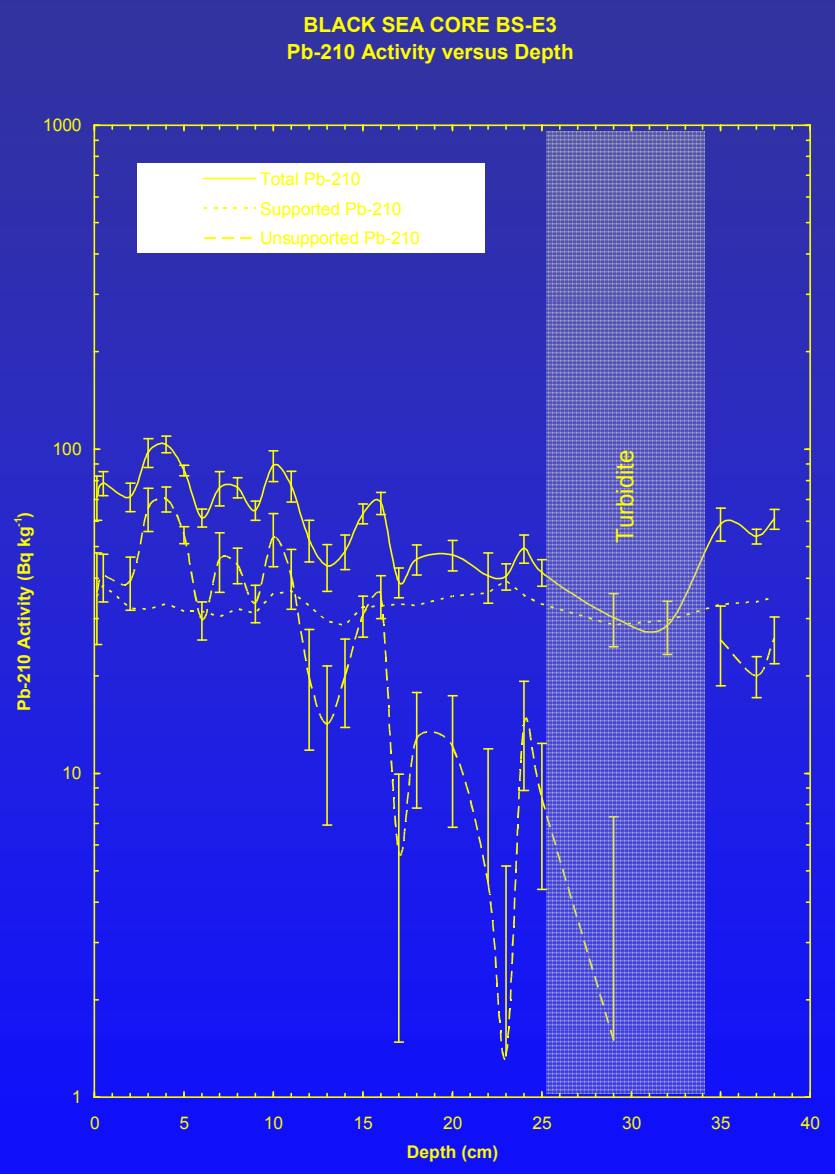
Примеры палео-климатических реконструкций температуры





Ранее донные осадки Черного моря не рассматривались как палеоклиматические архивы

Продельта Дуная



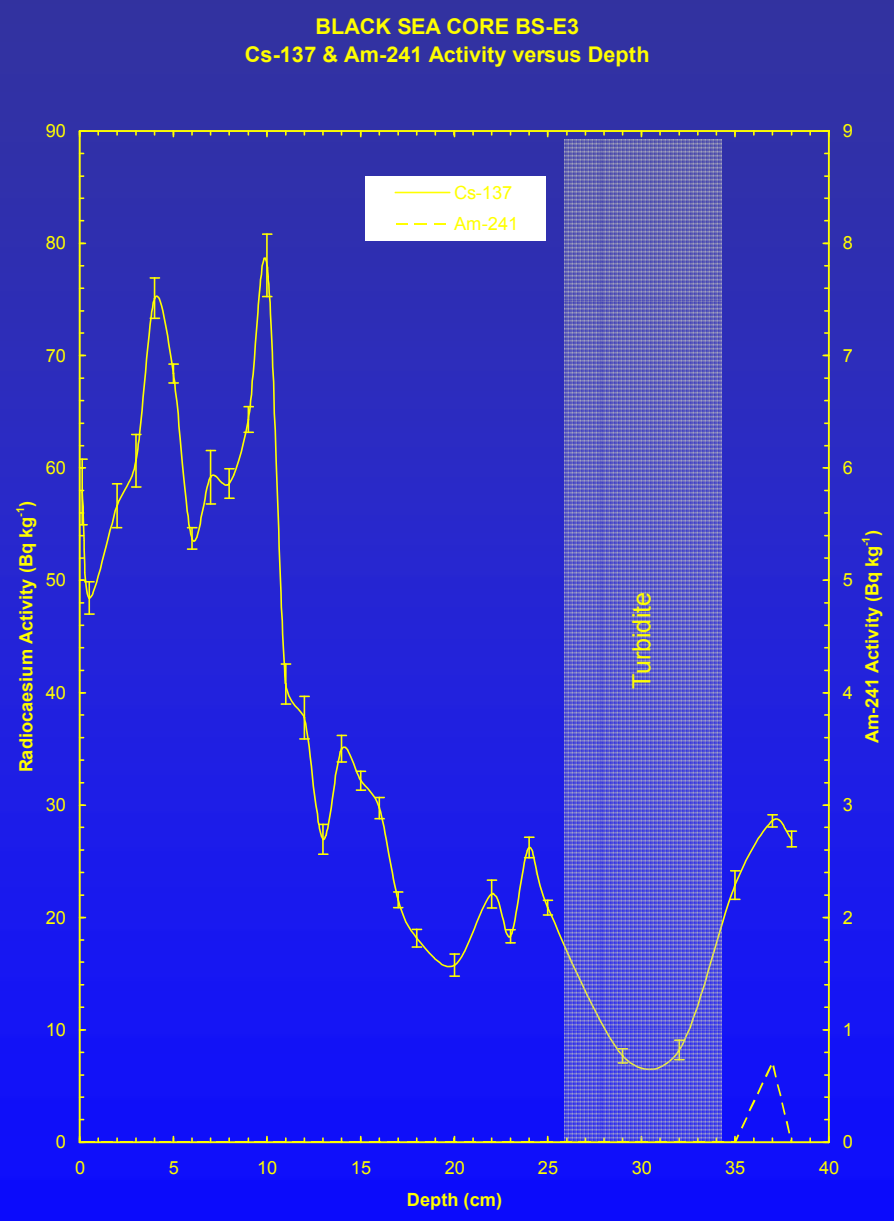


Fig. 1 – Sediment DBD and Radionuclide concentrations showing total, supported and unsupported ^{210}Pb, ^{137}Cs & ^{241}Am, Core BS-E3

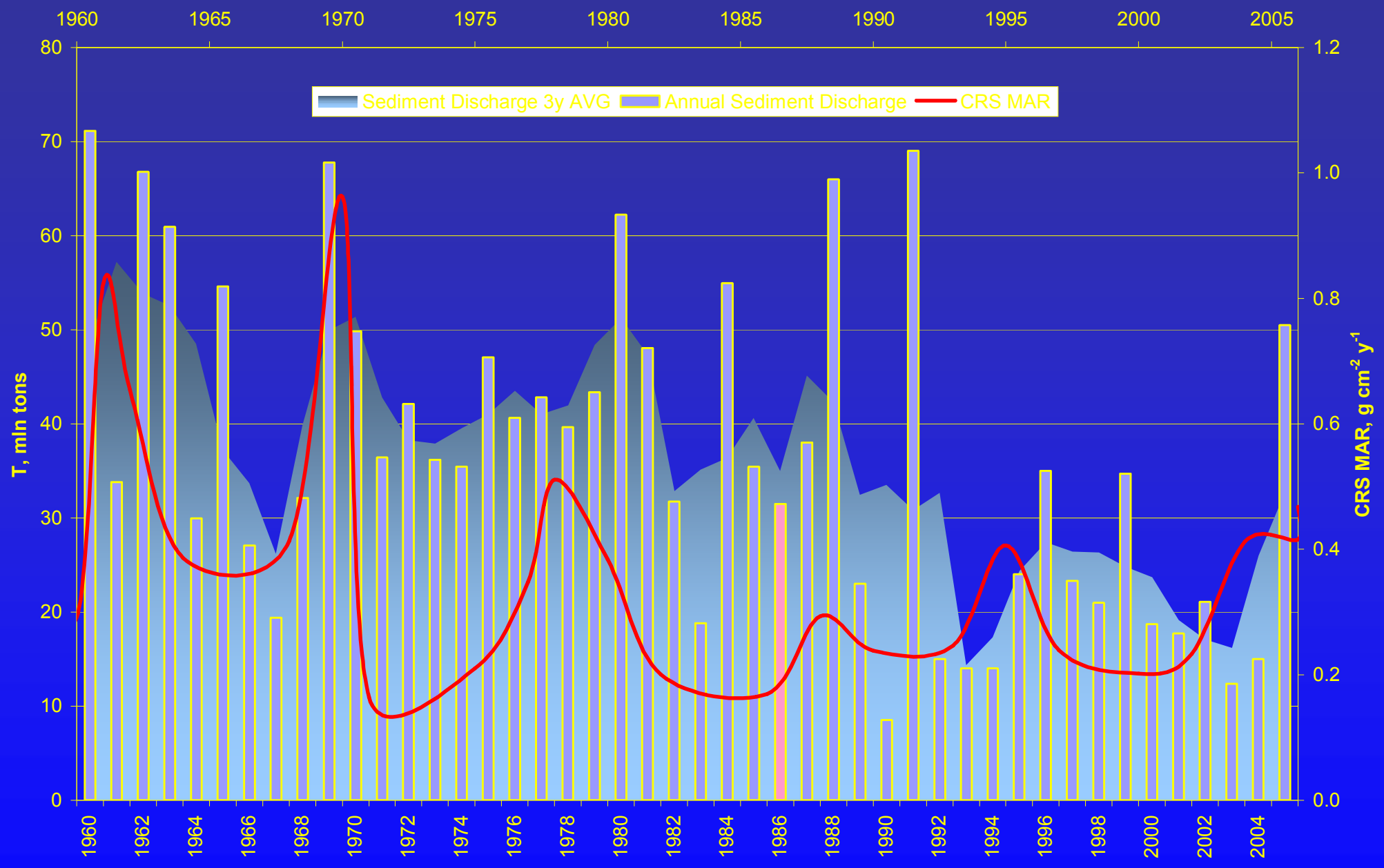


Fig. 1 – Danube sediment discharge (annual amount in mln.tons and 3year moving average) and CRS MAR for period of 1960-2005

Зависимость MAR-210Pb для Черного моря