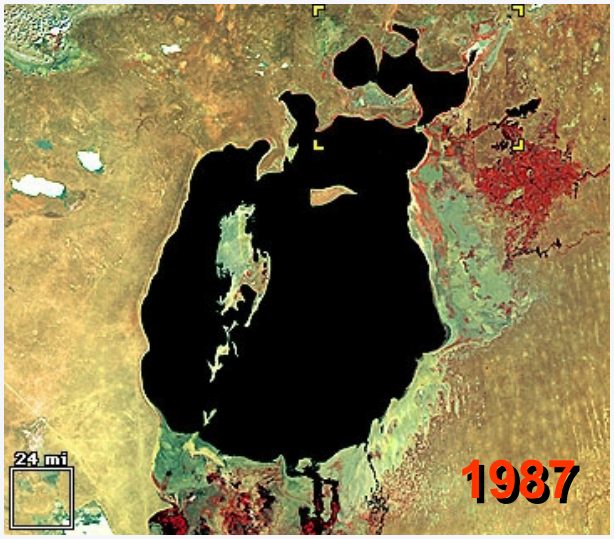
Nikolaus Boroffka
(Berlin)

Archaeology and its relevance to the history of climate and hydrology

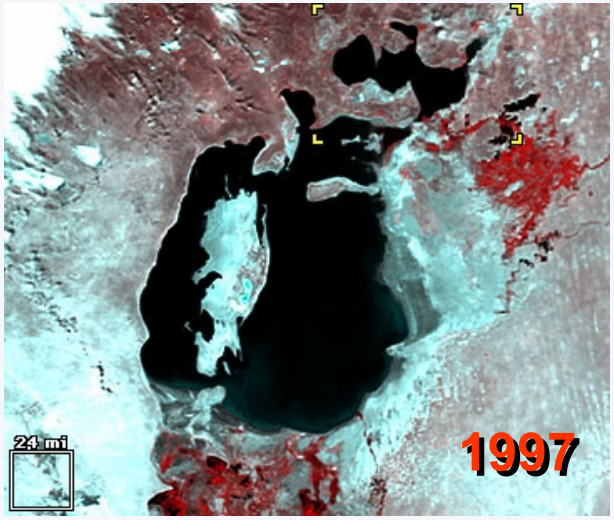
1. Modern change
2. Research history
3. Archaeological materials
4. Discussion
5. Conclusions

1. Modern Change



1960:
Surface: 68.000 km²
Volume: 1090 km³

End of the 1960s
large scale irrigation began
for cotton and rice



In the arly 1990s
the lake surface was
reduced to 50 %

the volume to only 30 %

Today (2003/2004):
Surface: 17.160 km²
Volume: 113 km³

Satellite images: USGS

Lenin

Akespe

Kyzyl Kum

2. Research History

E. Ehlers, Klimageschichte und Siedlungsgang in vor- und frühgeschichtlicher Zeit in der Turkmenensteppe Nordpersiens. Archäologische Mitteilungen aus Iran N. F. 4, **1971**, 7–17.

Б. В. Андрианов, Древние оросительные системы Приаралья (в связи с историей восникновения и развития орошаемого земледелия) (Москва **1969**).

С. П. **Толстов**/А. С. **Кесь** (eds.), Низовья Аму-Дарьи, Сарыкамыш, Узбой. История формированиф и заселения. Материалы Хорезмской Экспедиции 3 (Москва **1960**).

С. П. Толстов, Древний Хорезм. Опыт сторико-археологического исследования (Москва **1948**).

А. С. Кесь, Русло Узбой и его генезис. Труды института Географии 30 (Москва, Ленинград **1939**).

Л. **Бергъ**, Аральское Море. Опытъ физико-географической монографіи. Изв±стія Туркестанскаго Отд±ла Императорскаго Русскаго Географическаго Общесква 5. Научные резулбтаты Аральской экспедиціи снаряженной Туркест. отд±л. ИМП. Русск. Географич. Общества 9. (С.-Петербургъ **1908**).

Prince Kropotkin, The desiccation of Eurasia. The Geographical Journal 23, **1904**, Heft 6, 722–734.

R. I. Murchison/M. N. de Khanikoff, On the desiccation of the Tanghi-Daria, a branch of the Jaxartes. Journal of the Royal Geographical Society of London 14, **1844**, 333–335.

N. Boroffka/H. Oberhänsli/Ph. Sorrel/F. Demory/Chr. Reinhardt/B. Wünnemann/K. Alimov/S. Baratov/K. Rakhimov/N. Saparov/T. Shirinov/S. K. Krivonogov/U. Röhl, Archaeolgy and Climate: Settlement and Lake-Level Changes at the Aral Sea. Geoarchaeology 21.7, **2006**, 721-734.

B. van Geel/N. A Bokovenko/N. D. Burova/K. V. Chugunov/V. A. Dergachev/V. G. Dirksen/M. Kulkova/A. Nagler/H. Parzinger/J. van der Plicht/S. S. Vasiliev/G. I. Zaitseva, Climate change and the expansion of the Scythian culture after 850 B.C.: a hypothesis. Journal of Archaeological Science 31, **2004**, Heft 12, 1735–1742.

I. **Boomer**/N. **Aladin**/I. **Plotnikov**/R. **Whatley**, The palaeolimnology of the Aral Sea: A review. Quaternary Science Reviews 19, **2000**, 1259–1278.

А. В. Виноградов/Э. Д. Мамедов, Изменения климата и ландшафтов междуречья Амударьи и Сырдарьи (по археологическим и палеогеографическим данным). Аральский кризис (Историко-географическая ретроспектива) (Москва **1991**), 66-75.

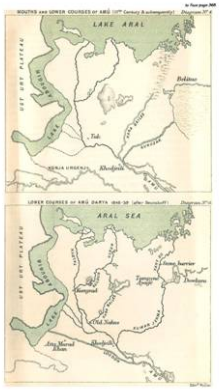
Д. В. Севастьянов/Э. Д. Мамедов/В. А. Румянцев (Hrsg.), История озер Севан, Иссык-Куль, Балхаш, Зайсан и Арал. История озер СССР [5] (Ленинград **1991**).

P. Gentelle, Prospections archéologiques en Bactriane Orientale (1974-1978) 1. Données paléogéographiques et fondements de l´irrigation. Mémoires de la Mission Archéologique Française en Asie Centrale 3 (Paris **1989**).

Geography

Butakoff 1848-49

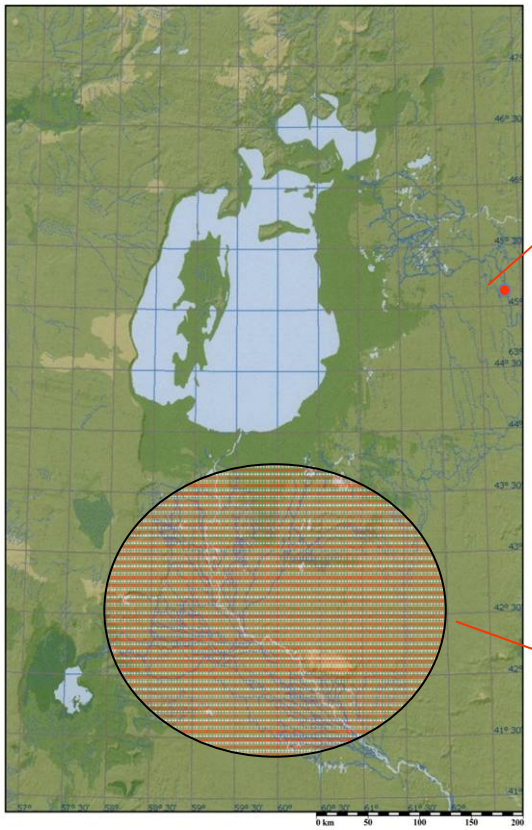
Wood 1875



Rawlinson 1879

Kropotkin 1904

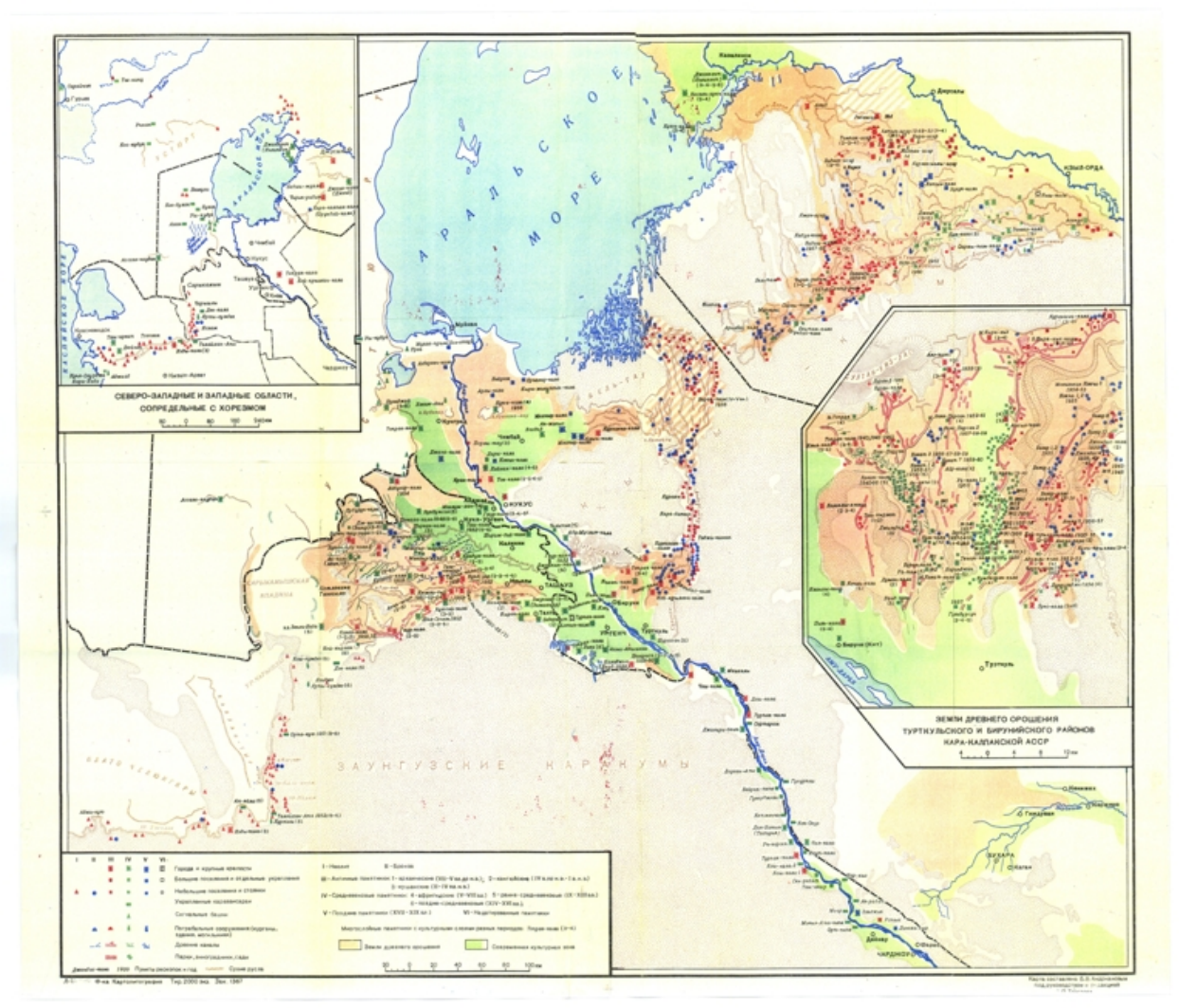
Archaeology



First interest:
(Лерх 1867)

First monument lists:
(Каллаур 1900-1903)

Khorezmian-Expeditions:
(Толстов et al.)
1930s to 1980s



The maps of S. P. Tolstov permitted first reconstructions of settlement shifts

Толстов 1962

Under leadership of

S. P. Tolstov

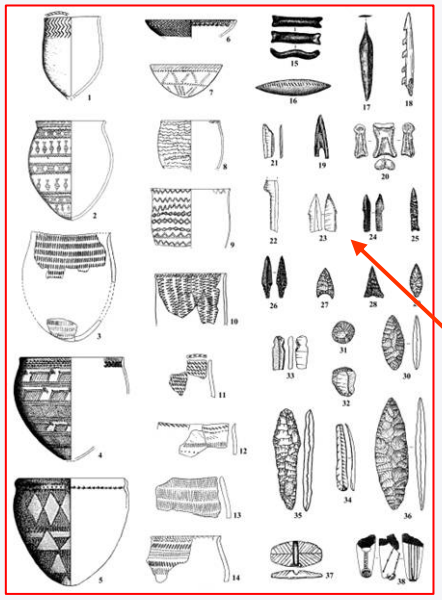
the collaboration between Archaeologists and Geosciences began, especially for the southern part of the Aral-Sea (Khorezmia)

e.g.
Толстов & Кесь 1960;
Виноградов & Мамедов 1975

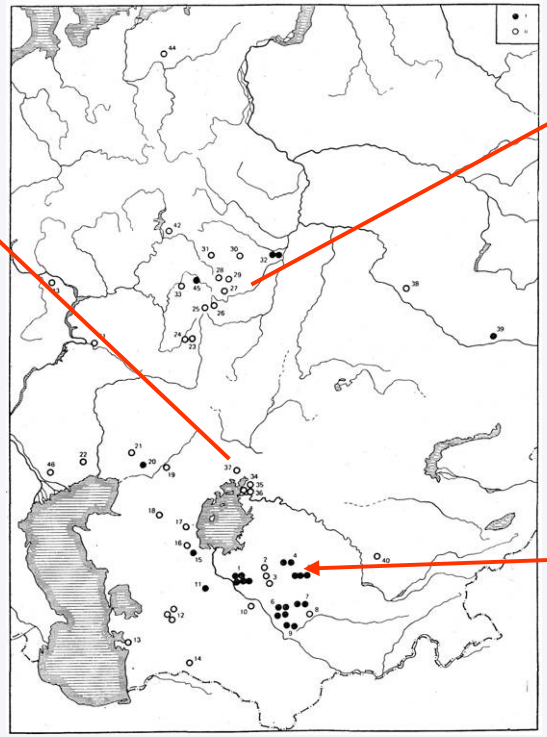
Today this would be „Geoarchaeology“

Толстов & Кесь 1960

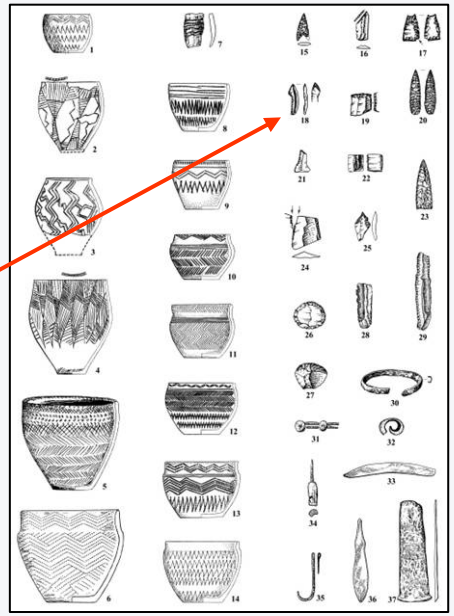
3. Archaeology

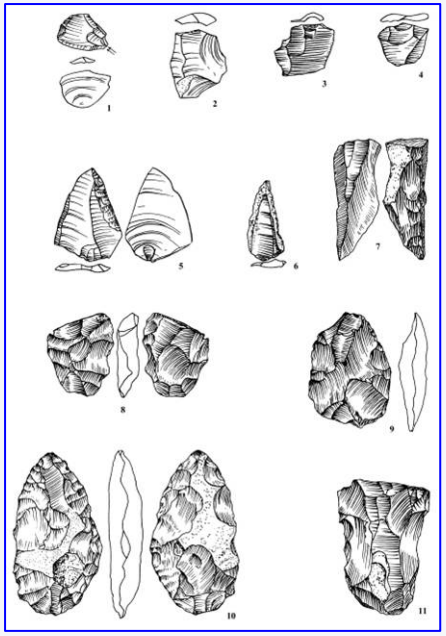


Eneolithic
(6.000-4.500 BP)

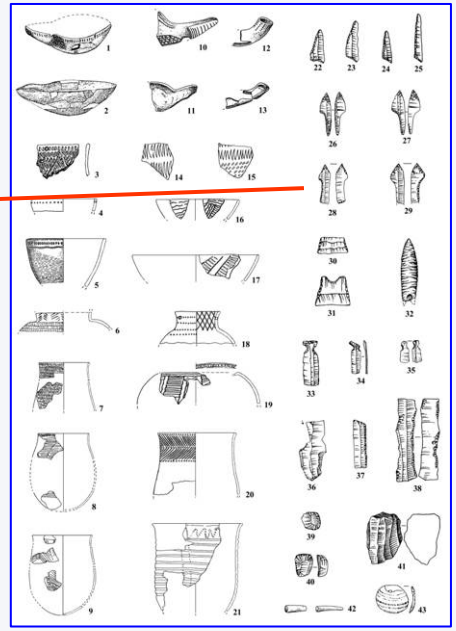


Early Bronze
(4.500-4.000 BP)



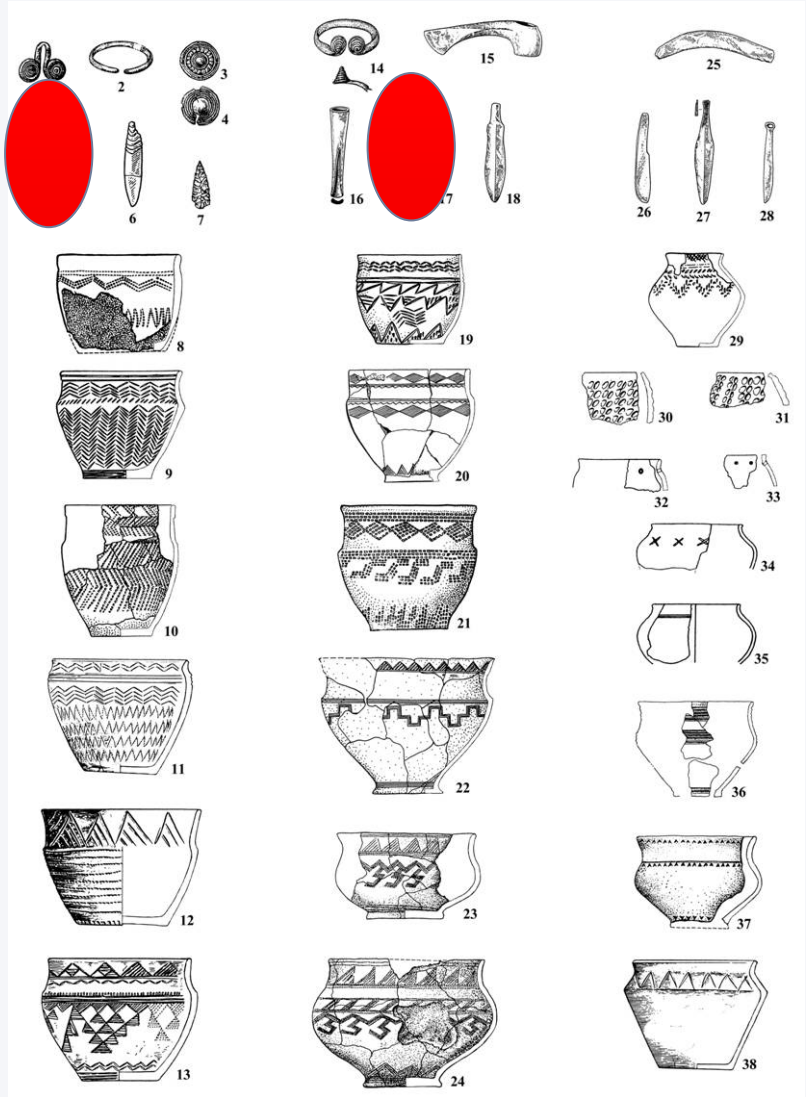


Palaeolithic
(50.000-35.000 BP)
Neandertal-Man

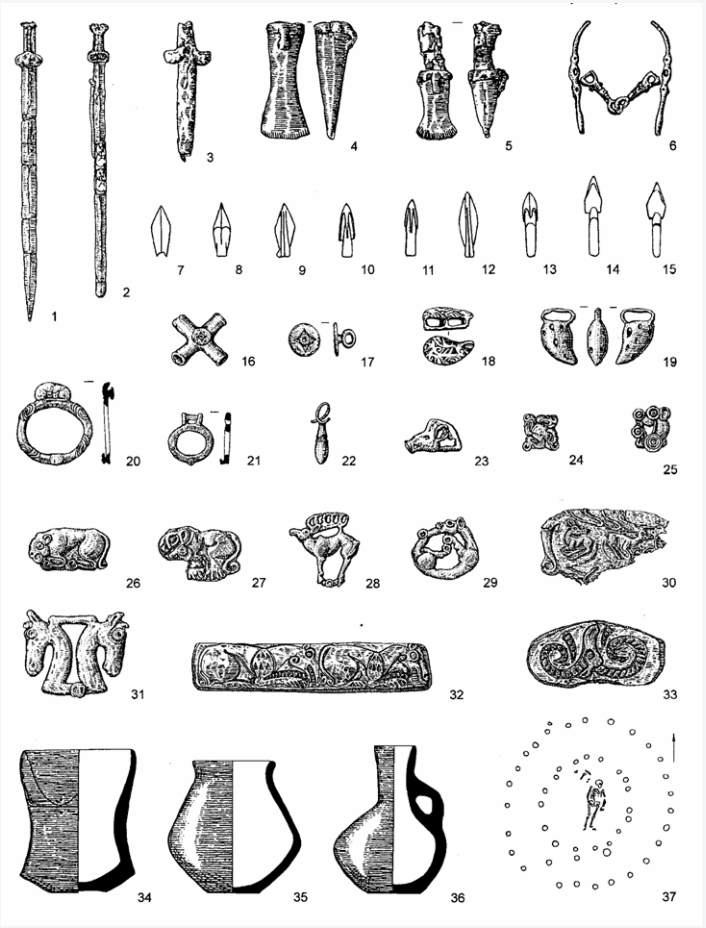


Resettlement after the 8.2ky event
Neolithic
(8.000-5.000 BP)
Homo sapiens

Виноградов 1979; Szymczak/Khudzhanazarov 2006; Boroffka 2009 (in print)

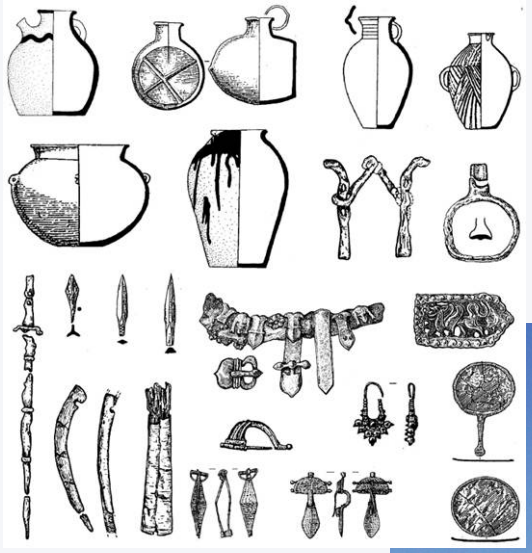


Bronze Age (4.000-3.000 BP)

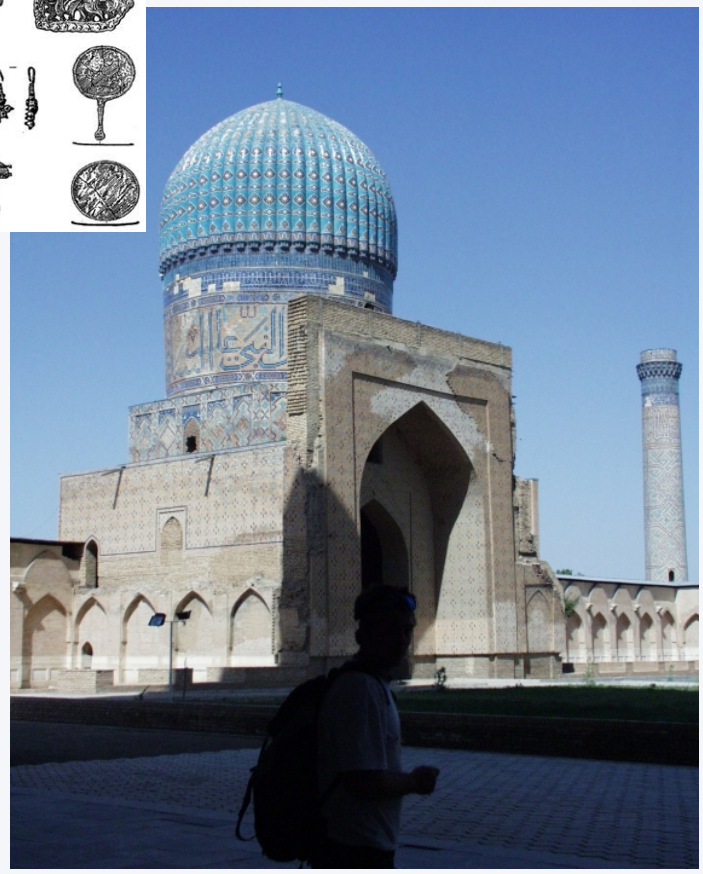


Iron Age (3.000-2.300 BP)

Antiquity
(2.300.000-1.500 BP)



Middle Ages
(1.500-500 BP)

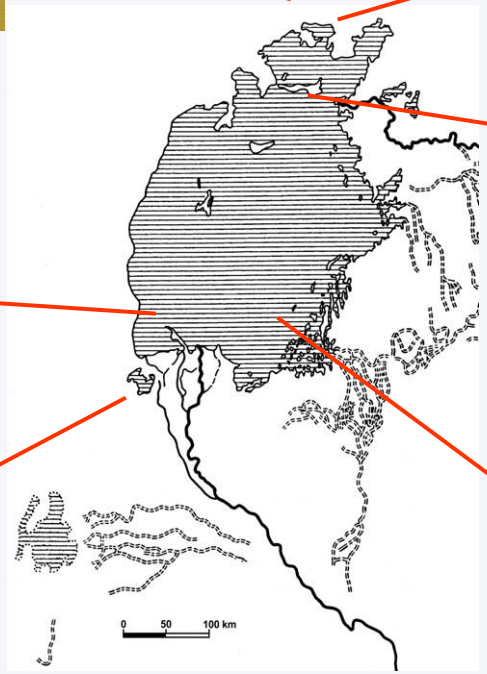


4. Discussion

Akespe

Tastubek

SW Aral bed

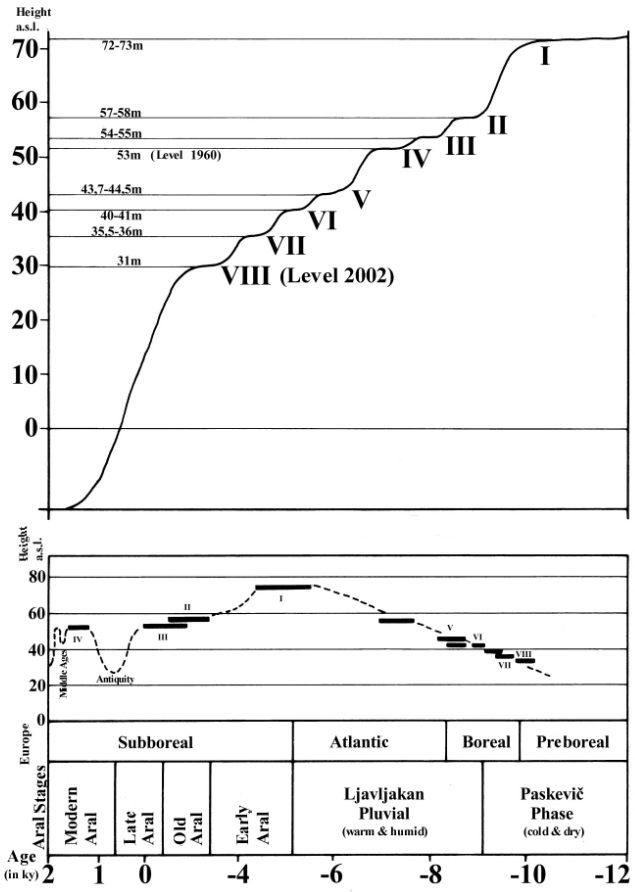


Kerderi

Pulzhaj

SE Aral bed

Summarised oscillations of water levels of the Aral Sea



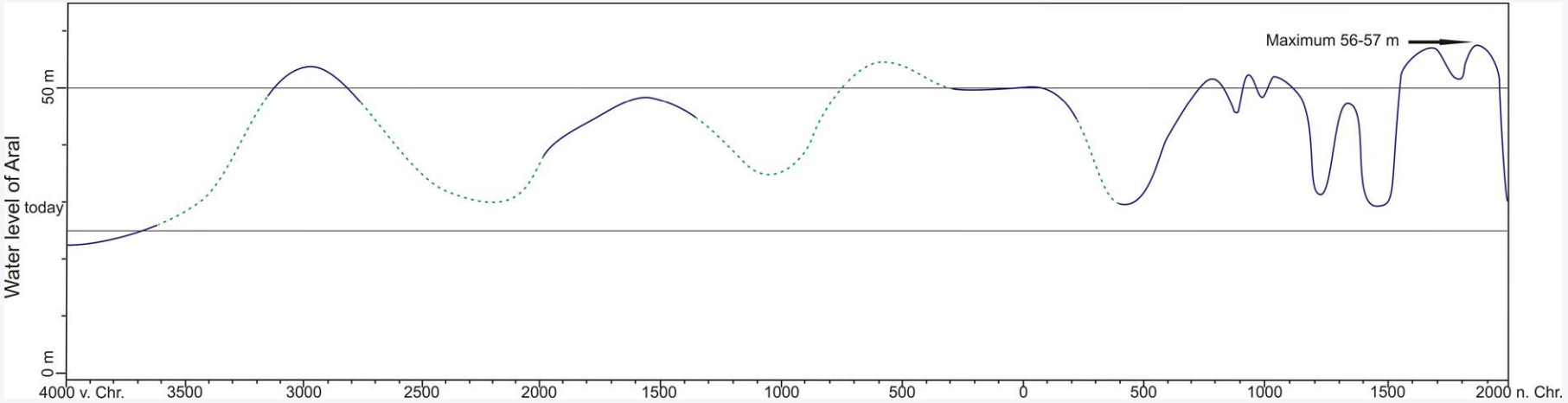
Terrace I (72/73 m a.s.l.) can not be confirmed for any part of the Holocene

Terrace II (57/58 m a.s.l.) can not date from 3000/4000 BP (Bronze Age settlements lie at lower elevations)

The Bronze & Iron Age water level probably lay at 42 m a.s.l.

The medieval regression was lower than 30 m a.s.l. (Water level 2003; Kerderi, Pulzhaj)

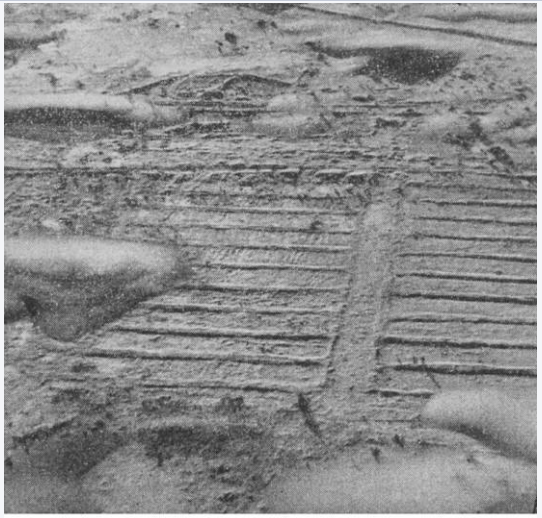
Boomer et al. 2000



Possible reasons for water level oscillations

- Climate
- Natural changes of river courses (e.g. earthquakes, tektonics)
- Artificial changes of river courses (e.g. war)
- Irrigation



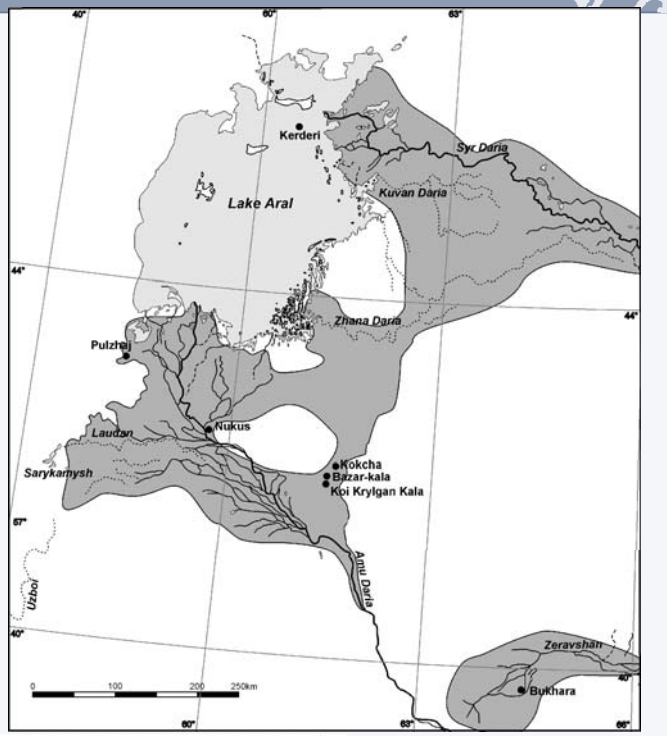



Koj Krylgan Kala
Vinyards
4th Cent. BC
to
4th Cent. AD

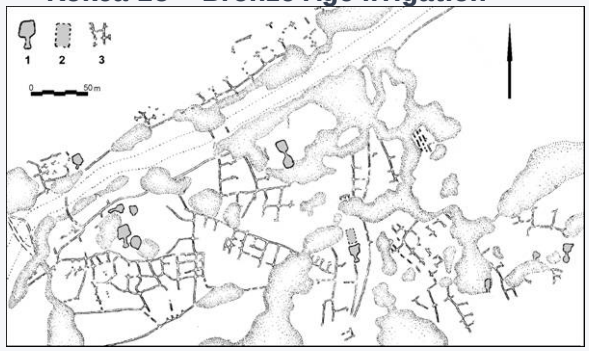
Akča Darja
Fields
11th-13th Cent. AD

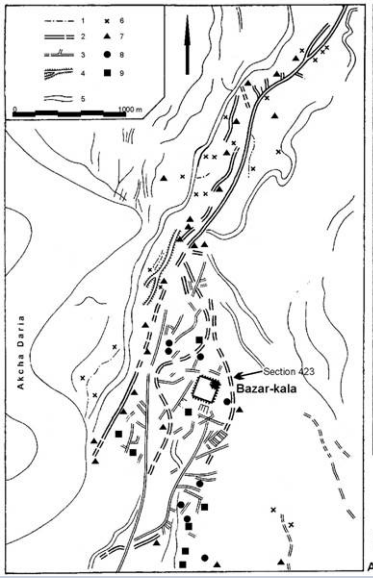
Irrigated surfaces (Antiquity-Middle Ages):
5-10 Mio. ha.

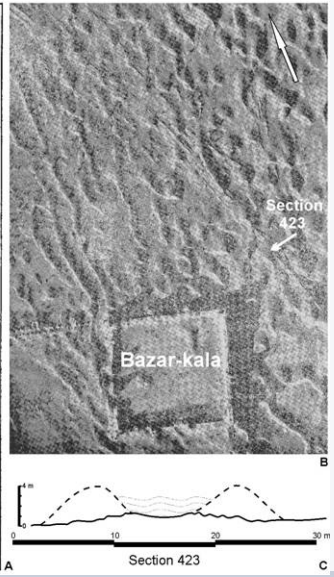
Soviet Union:
6,5 Mio. ha.



Kokča 15 – Bronze Age irrigation

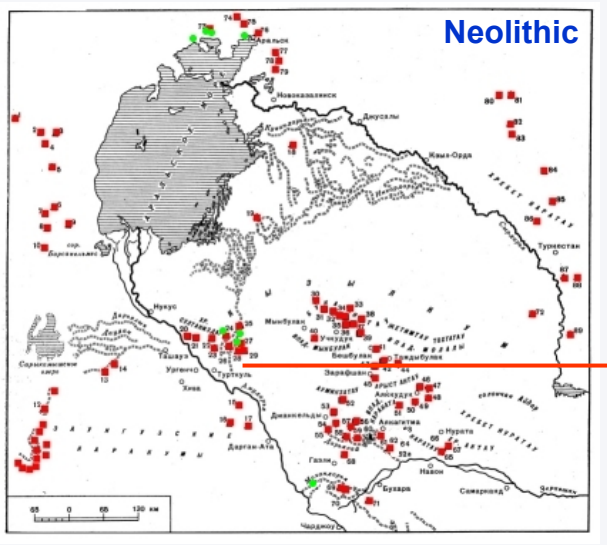


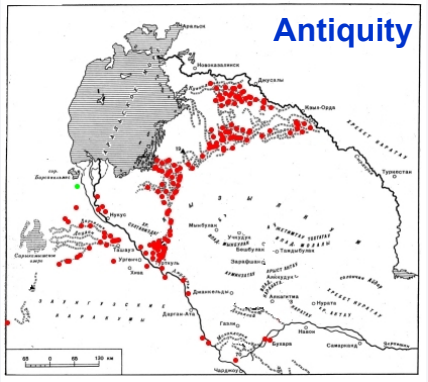


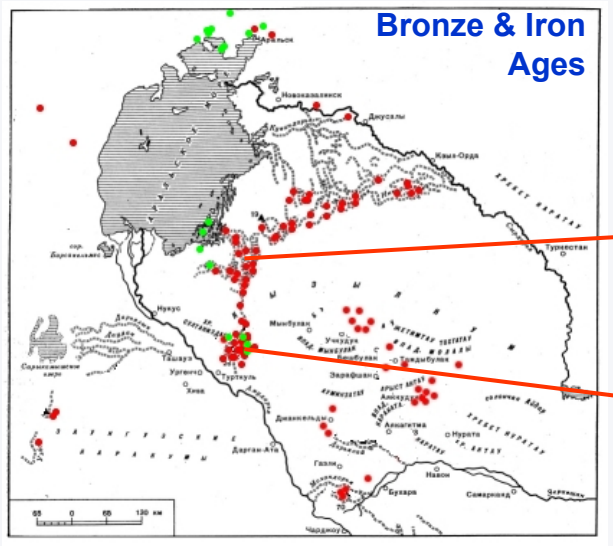


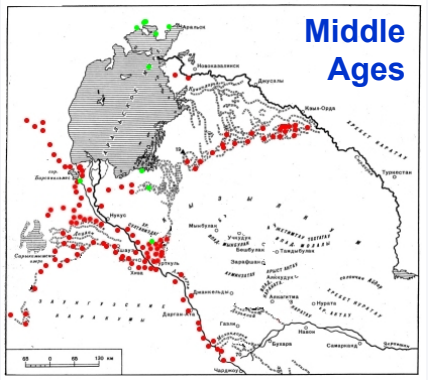
Bazar Kala
Canals of:
Bronze Age (1)
Iron Age (2)
Antiquity (3)

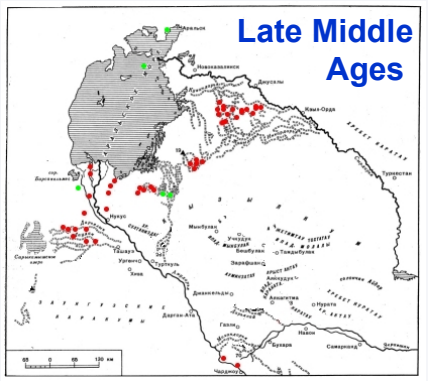
Oberhänsli et al. 2007





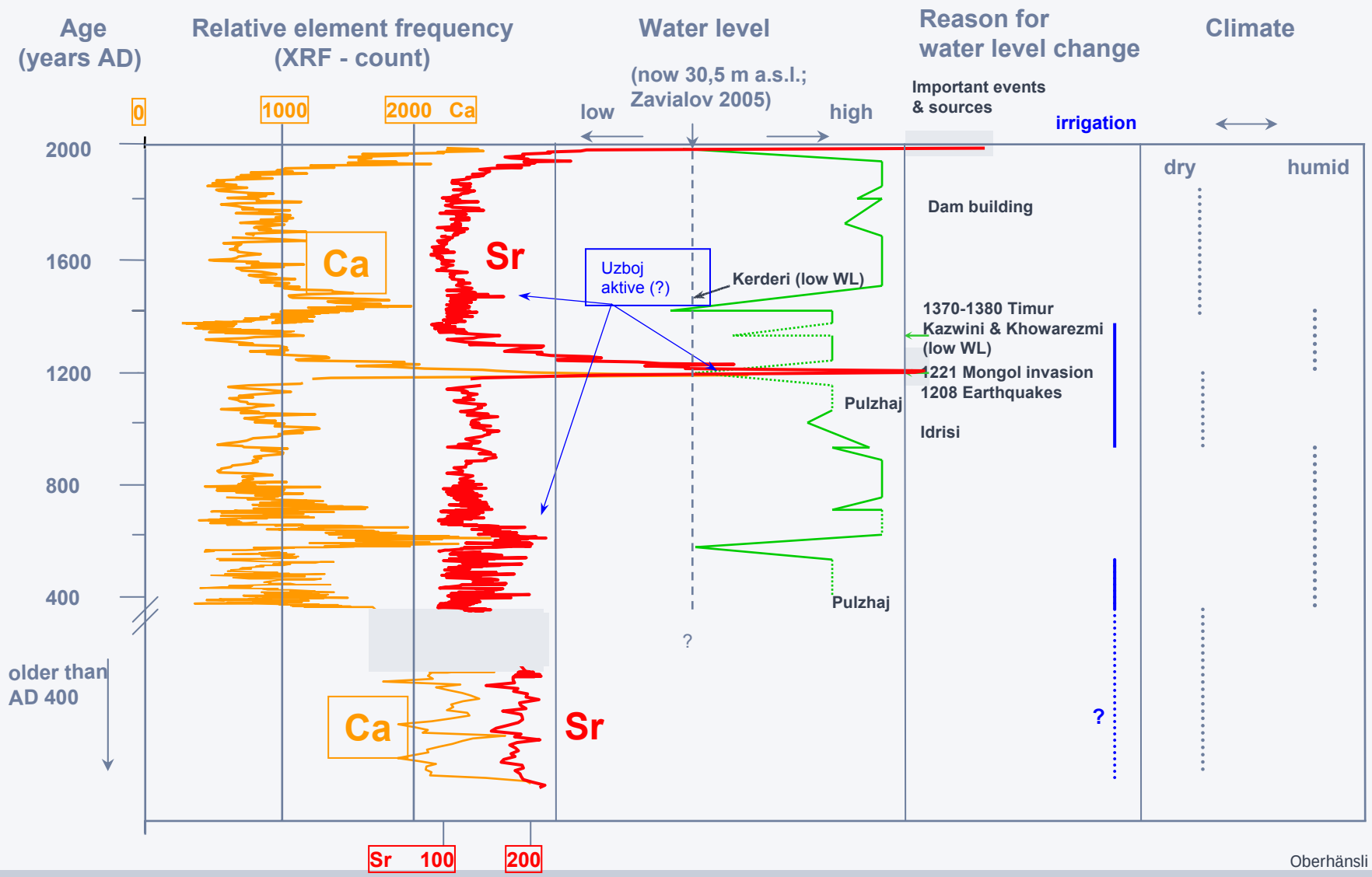






Толстов & Кесь 1960; Толстов 1962 ; Виноградов 1981; Boroffka 2009 (in print)

12 m CLIMAN – Core from Chernyshev-Bay, N-W Aral-Sea



Oberhänsli et al. 2007

Major earthquakes in western Central Asia (Melville 1980):

1145	(540 H.)
1208/1209	(605 H.)
1251	(649 H.)
1270	(669 H.)
1389	(791 H.)
1405	(808 H.)

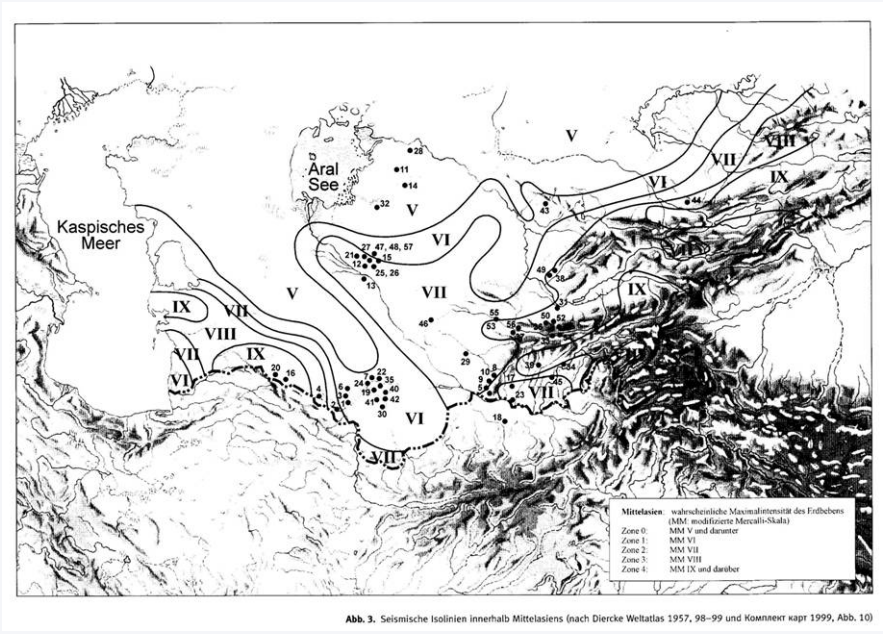
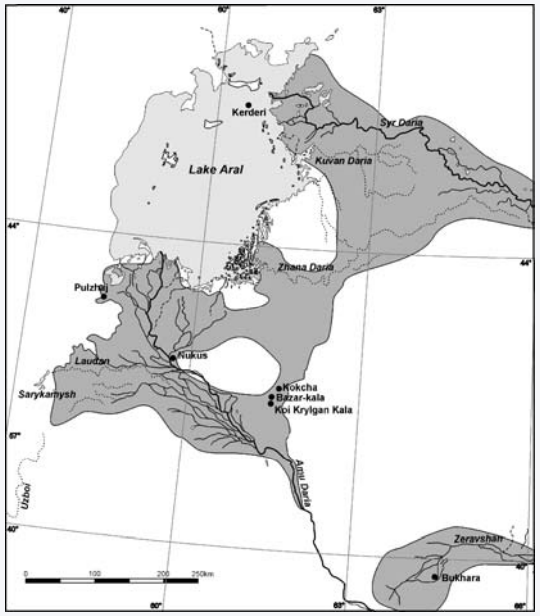


Abb. 3. Seismische Isolinien innerhalb Mittelasiens (nach Diercke Weltatlas 1957, 98–99 und Комплект карт 1999, Abb. 10)

Baimatowa 2008



According to medieval (arab and persian) reports the Amu Dar´ja drained to the Aral until the Mongol invasion in 1221.
Later water is repeatedly mentioned in the Uzboj

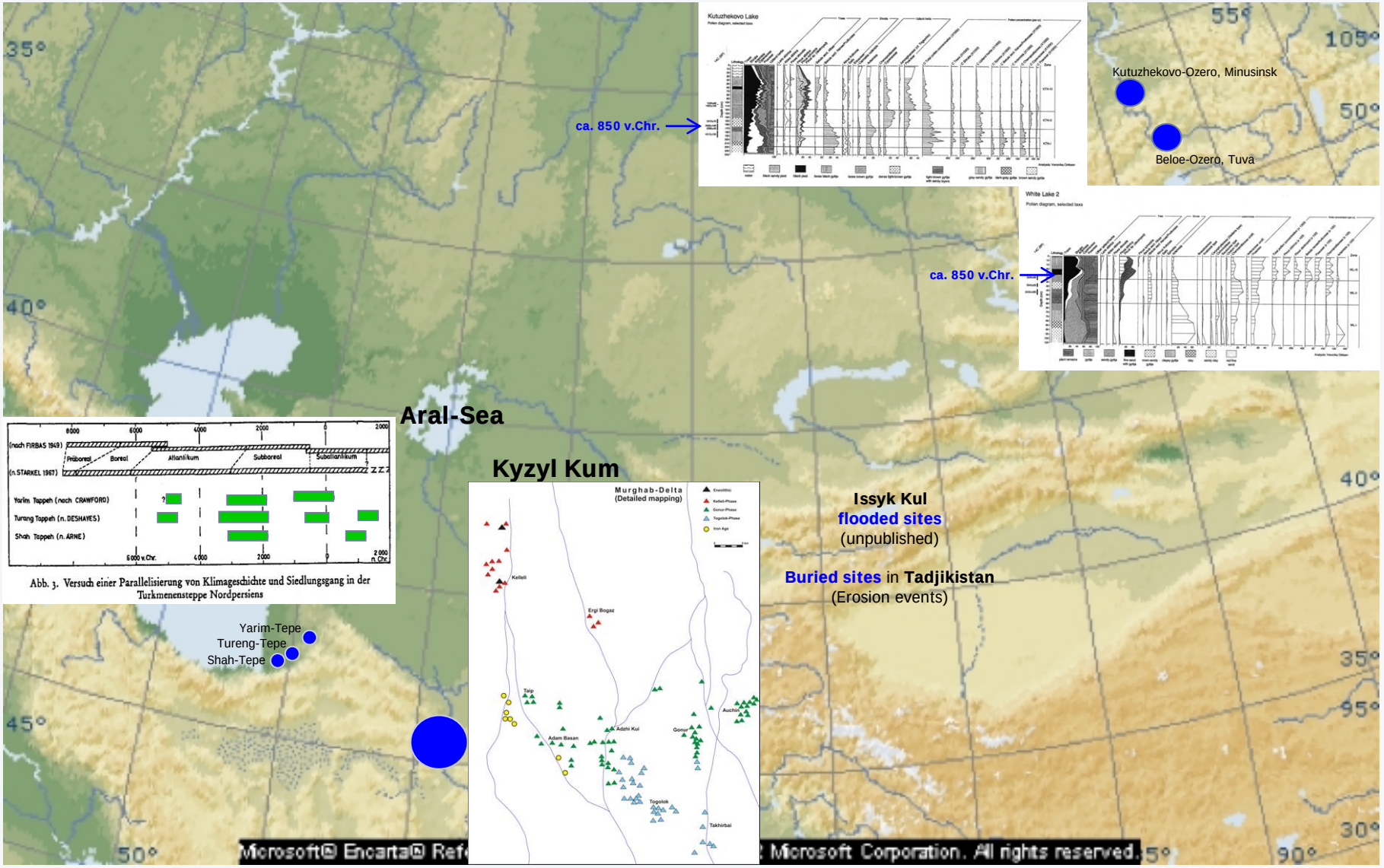
Hamdallah Kazwînî in 1339 mentions Aral only as salt lake and Bedr-ad dîn al Khowârizmi does not mention it at all when describing the Syr Dar´ja

In the war against Khorezmia Timur in the 1370s-1380s destroyed irrigation structures

A. Jenkinson in 1558 describes gardens on the Uzboj (?)

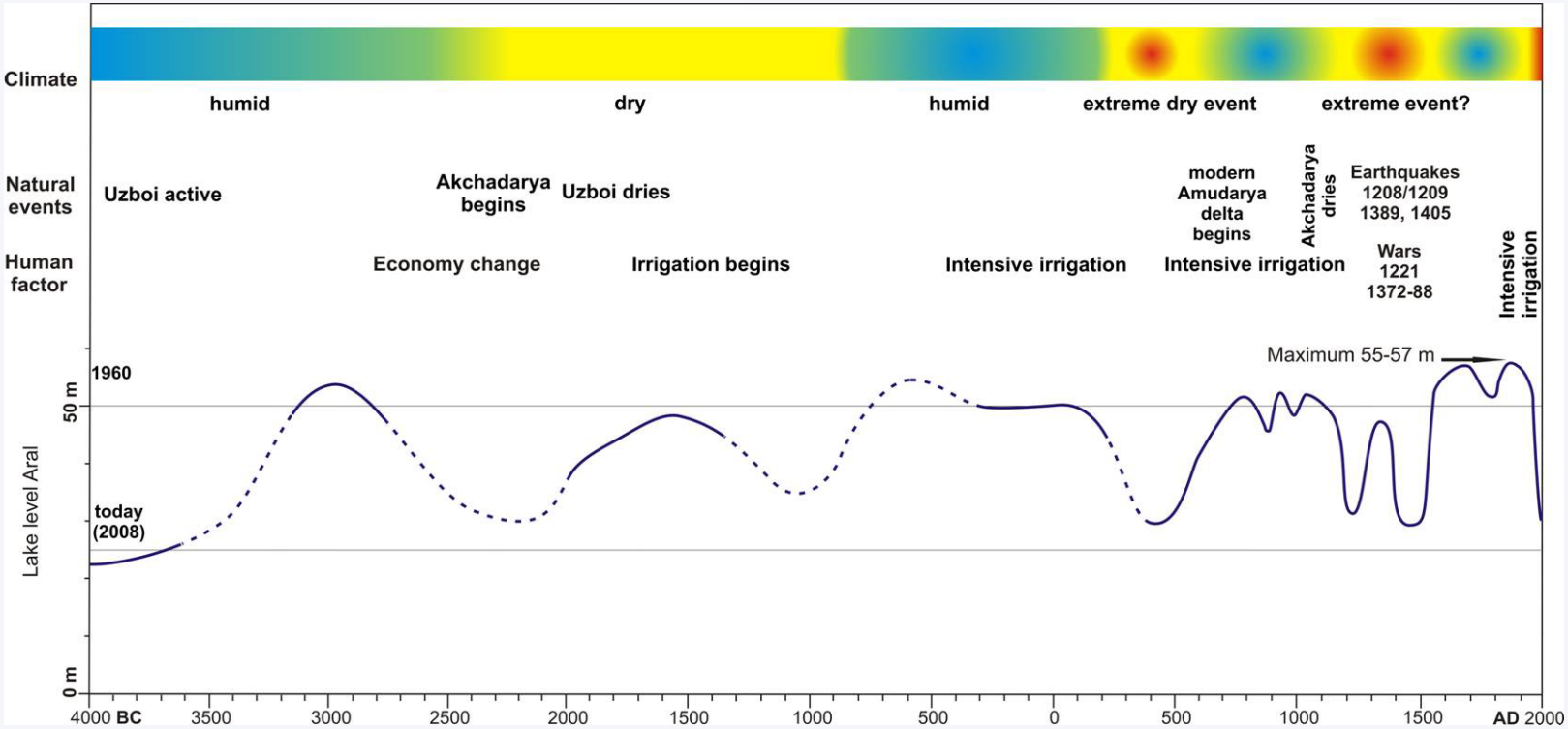
Khan Abulghazi (1603-1663) reports that the Amu Dar´ja drained to the Aral again only 30 years before his birth (i.e. 1573)

Barthold 1910; Oberhänsli et al. 2007

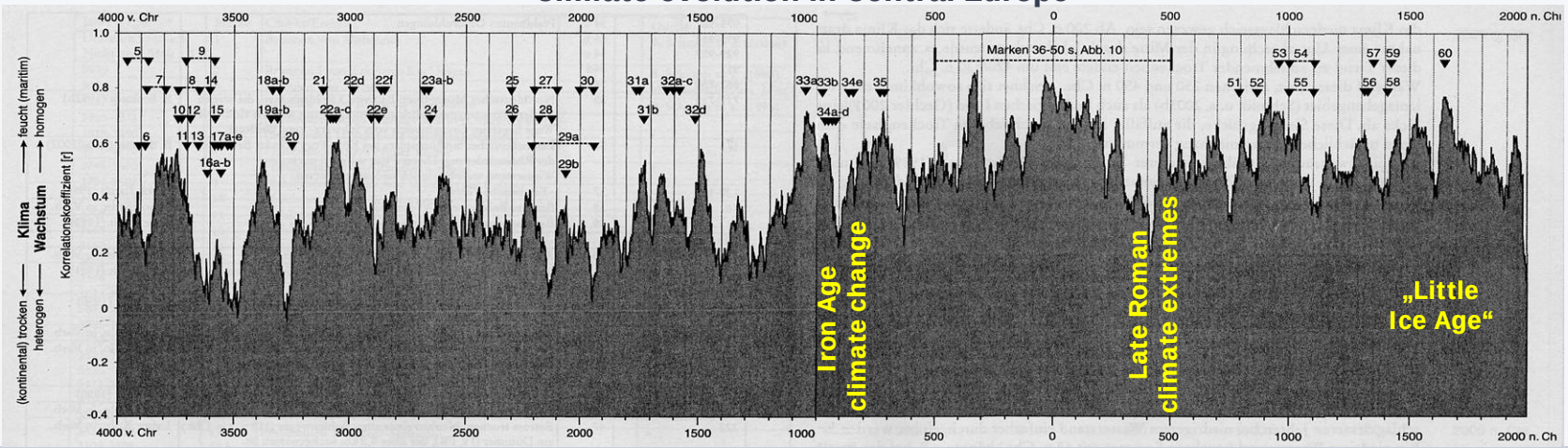


Ehlers 1971; Kohl 1984; Dirksen et al. 2003

Water levels of the Aral Sea and climate reconstruktions for Central Asia



Climate evolution in Central Europe



Conclusions

1. The Aral during the Holocene never had a higher water level (72/73 m a.s.l.) than in the 1960s (54/55 m a.s.l.)
2. Changes in cultural orientation, economy and settlement structure in the Eneolithic and the Early Bronze Age (3000-2000 BC) were dependent on climate
3. Probably the Amu Dar´ja before the Bronze Age (2000 BC) did not flow to the Aral Sea
   This explains a low lake level until the Bronze Age, in spite of a humid climate
4. The low water level of Aral (42 m a.s.l.) in the Bronze and Iron Ages (2.000-800 BC) was identified only recently
   A climate change from 850 BC led to higher water levels
5. Since classical Antiquity (ca. 600 BC) the human factor (irrigation) is important
6. In Antiquity and the Middle Ages major regressionsn of the Aral Sea were caused by climatic and human factors
7. Shortly after AD 1200 a very prominent Sr peak shows that the Amu Dar´ja did not contribute significantly to the water balance of Aral
   Probably it drained through the Uzboj to the Caspian Sea
   The reasons were natural (Earthquakes) and/or human (Mongol invasion)
8. The Iron Age climate change, a Late Roman climate extreme and the „Little Ice Age“ are identifiably in Central Asia similarly to Central Europe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Thank You for your attention!