INTERACTION OF ICE-RAFTED SEDIMENTS AND SURFACE SEAWATER USING SHORT- & LONG-LIVED NUCLIDE TRACERS

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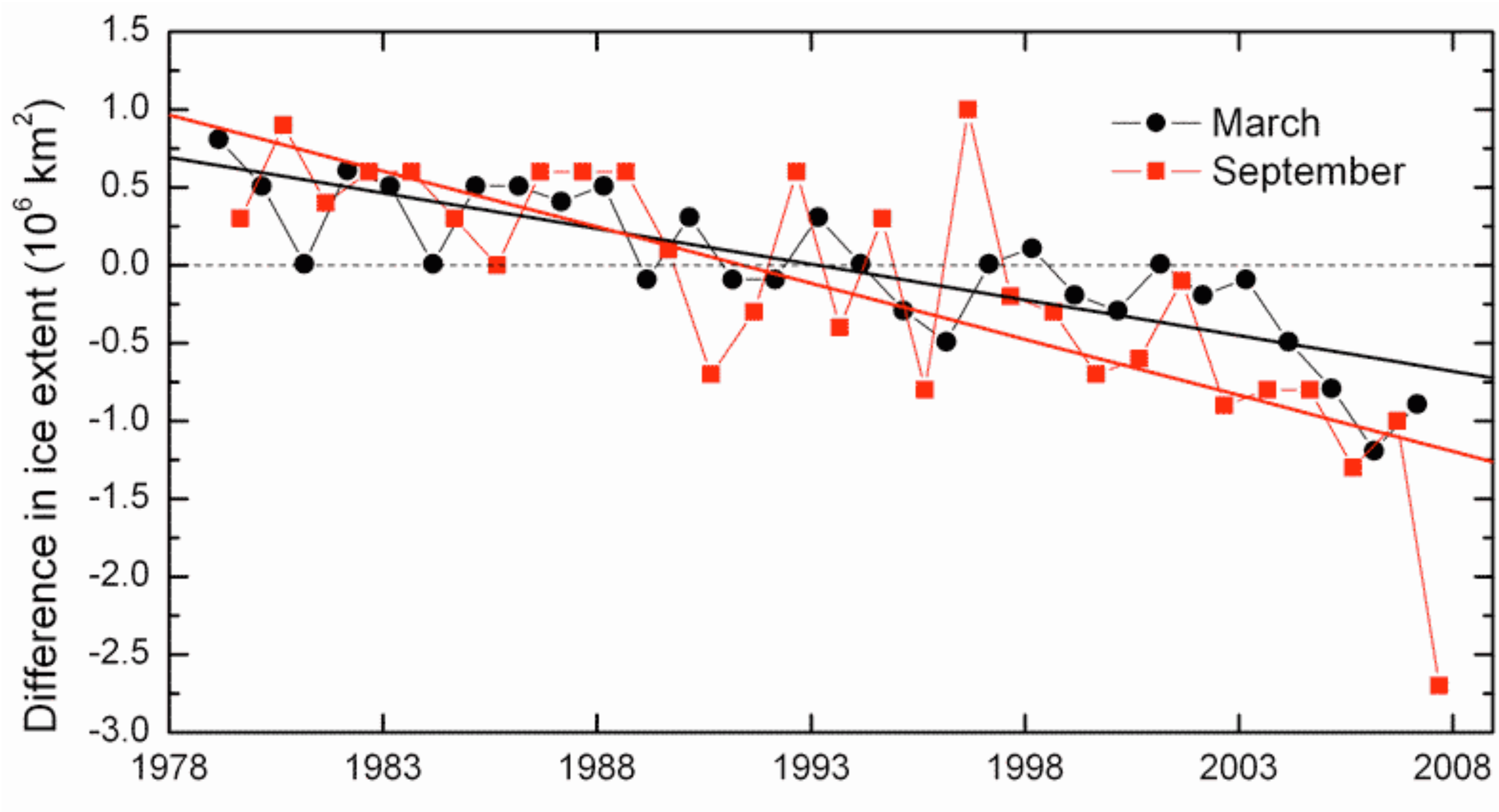


1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
Difference in ice extent (10^6 km^2)
1978
1983
1988
1993
1998
2003
2008
March
September

WHY SEA ICE STUDIES?

- Ice-Albedo feedback & summer radiation balance depend on the concentration, distribution and composition sea ice sediments
- Mechanism of sediment incorporation is important for:
  - Sea ice associated with significant biomass & important role as a habitat
  - Primary production
  - Marine food web
  - Sediment dynamics in shallow seas
  - Sedimentation in deep basin dominated by ice-rafted material
  - Redistribution and dispersal of pollutants

WHY SEA ICE STUDIES?

- Sea ice transport of sediments – most rapid & efficient mechanism of cross-shelf transported linking areas of increased coastal erosion in the Arctic directly to the deep basins

- Processes related sea ice formation, drift and melt appear to play a key factor governing surface ocean metal concentrations (evidence from Al and possibly Fe and other elements)

KNOWN KNOWNS

- 2-3 Orders of magnitude higher ^{210}Pb & ^{7}Be in IRS compared to benthic sediments (Pere Masque's group ours)
- BERINGIA-2005 results indicate excess ^{234}Th in IRS – Time scale of interaction of IRS and surface water
- Distinctly different Nd isotopic composition in IRS collected from a small area (source regions are very different)

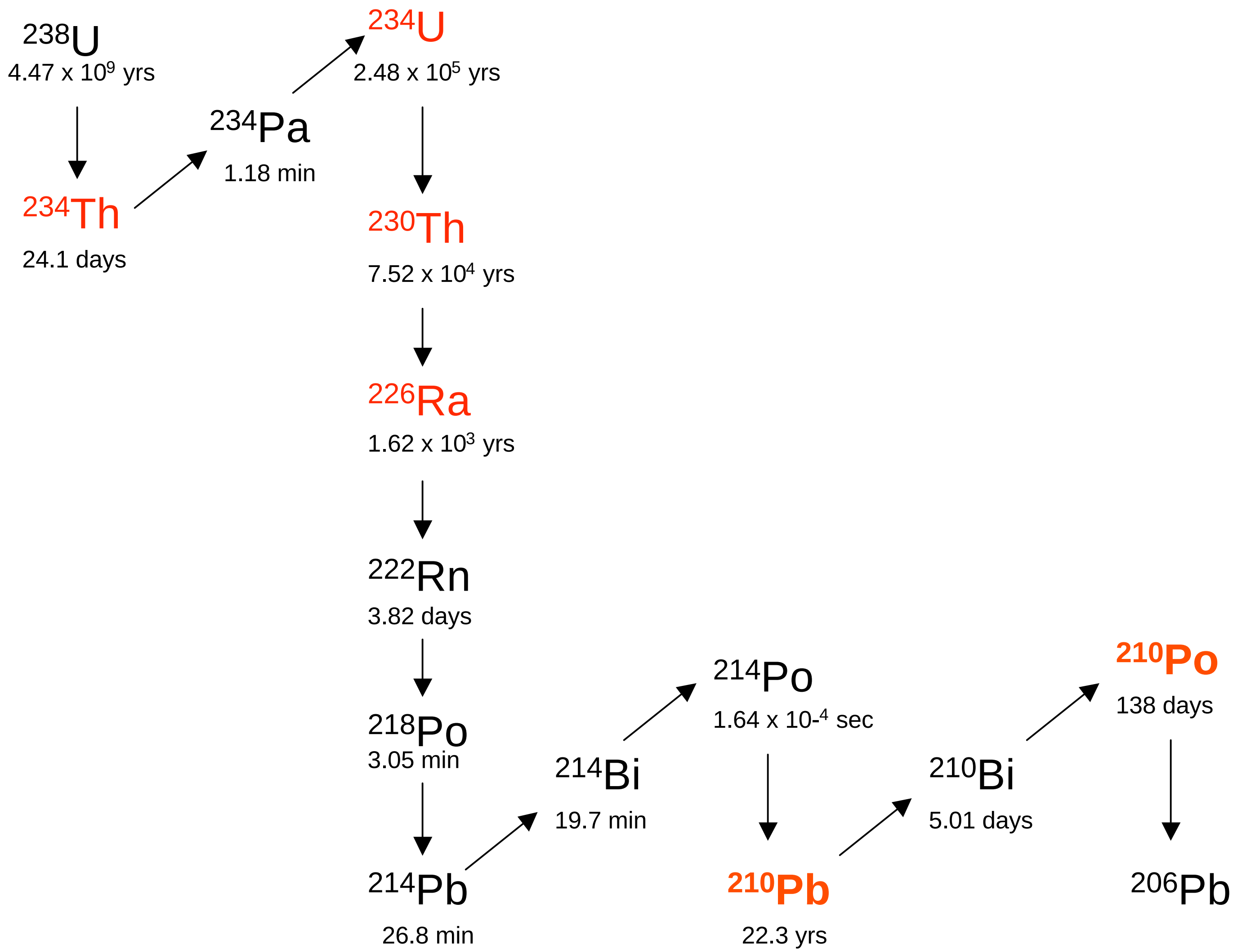
KNOWN KNOWNS – CONTD.

- Varying $^{87}Sr/^{86}Sr$ isotopic composition in IRS collected from a small area
- Highly varying activities of ^{7}Be, ^{210}Pb, ^{210}Po, etc in IRS collected from ~10 m^2 ice block
- Disequilibrium between various members of U-Th series radionuclides ($^{234}Th/^{238}U$, $^{210}Pb/^{226}Ra$, $^{210}Po/^{210}Pb$) in IRS

KNOWN UNKNOWNS

- MECHANISMS OF INCORPORATION OF ^{7}Be, ^{210}Pb IN SEA ICE SEDIMENTS (FROM SEA ICE TO IRS & AMOUNT DERIVED FROM SORPTION FROM SURFACE SEAWATER)
- SOURCE REGIONS OF SEDIMENTS FOR **IRS**
- HOW HETEROGENOUS **IRS** ARE (WITH RESPECT TO THEIR SOURCES AS EVIDENCED BY Nd, Sr ISOTOPIC COMPOSITION)
- RESIDENCE TIMES OF **IRS** IN SEA ICE
- EXTENT OF RECYCLING OF **IRS** (HOW MANY FREEZING/MELTING CYCLES BEFORE THEY ARE REMOVED)
- ROLE OF MELT PONDS IN THE TRANSFER OF RADIONUCLIDES FROM SEA ICE TO **IRS**

^{238}U radioactive decay chain.



Isotopes of Interest

Ice-Rafted Sediments, Sea Ice (includes cores, sea ice algae):

- ^{210}Po, ^{210}Pb (^{226}Ra), ^{230}Th (^{234}U)
- ^{7}Be & ^{10}Be
- ^{137}Cs
- ^{143}Nd/^{144}Nd Isotopes
- ^{87}Sr/^{86}Sr isotopes
- All these nuclides in surface (about 2-5 m below sea ice) water, melt ponds – both dissolved and particulate phases