Seasonal variability of iron concentration in the Oyashio region

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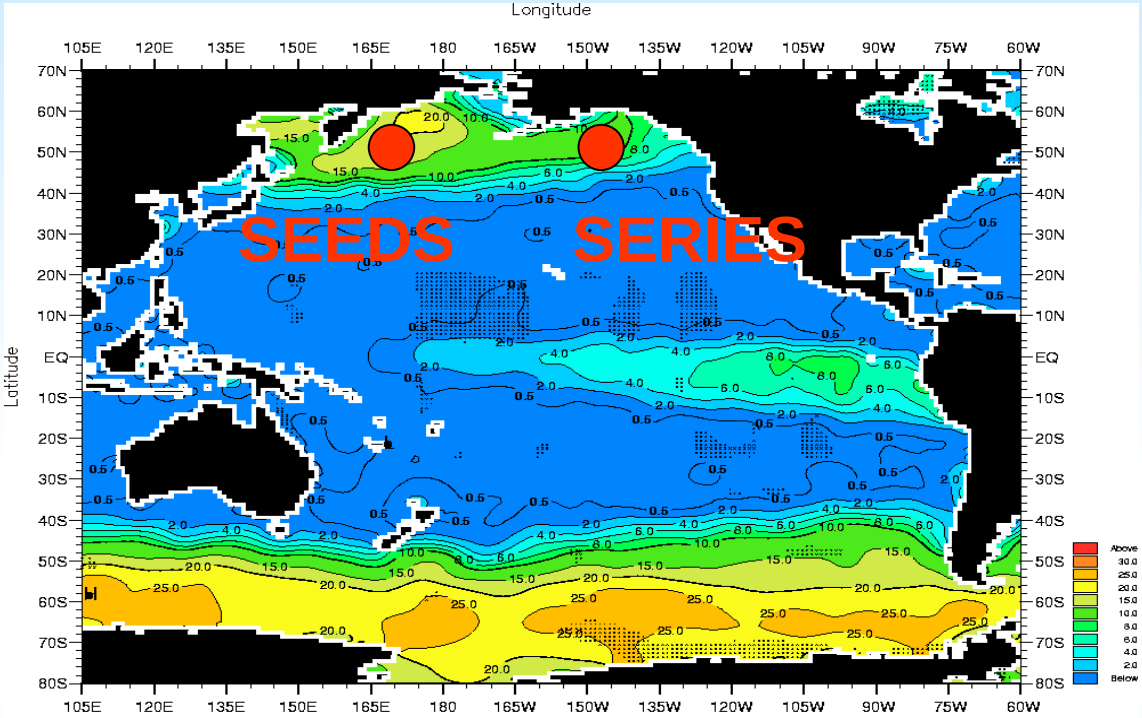
Time series observation was conducted!

Iron fertilization experiment in the subarctic Pacific



Iron is an essential nutrient

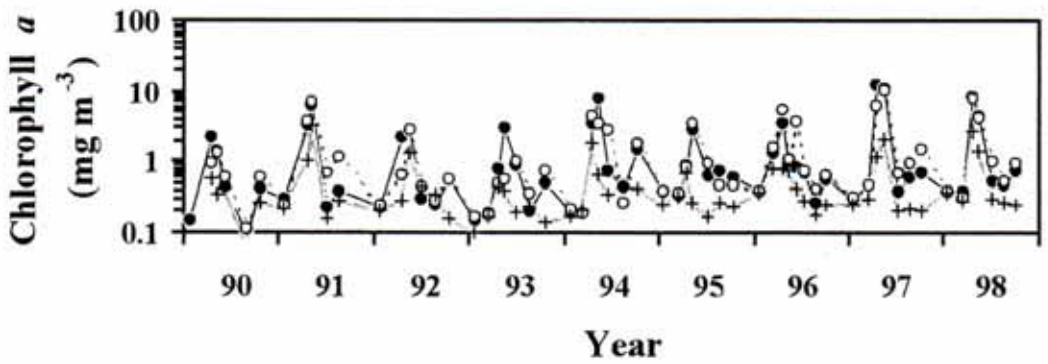
Iron limits phytoplankton production in subarctic Pacific
(Tsuda et al., 2003; Boyd et al., 2004)

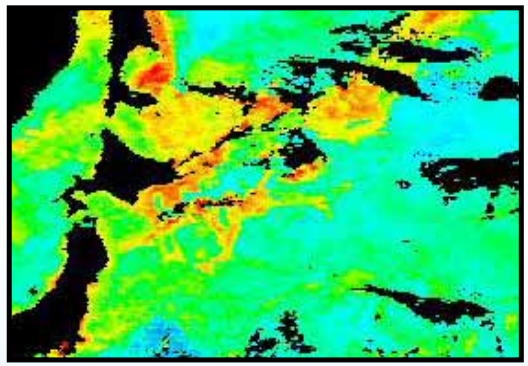
Phytoplankton bloom in the Oyashio region

Seasonal variation of Chlorophyll a concentration (mg/m^3)

Oyashio	WSP	ESP
0.3-8	0.2-1.6	0.3-0.4

(Saito et al., 2002; Imai et al., 2002; Boyd and Harrison, 1999)





Phytoplankton bloom
in May 2003

Oyashio region has steady spring phytoplankton bloom (Saito et al., 2002)

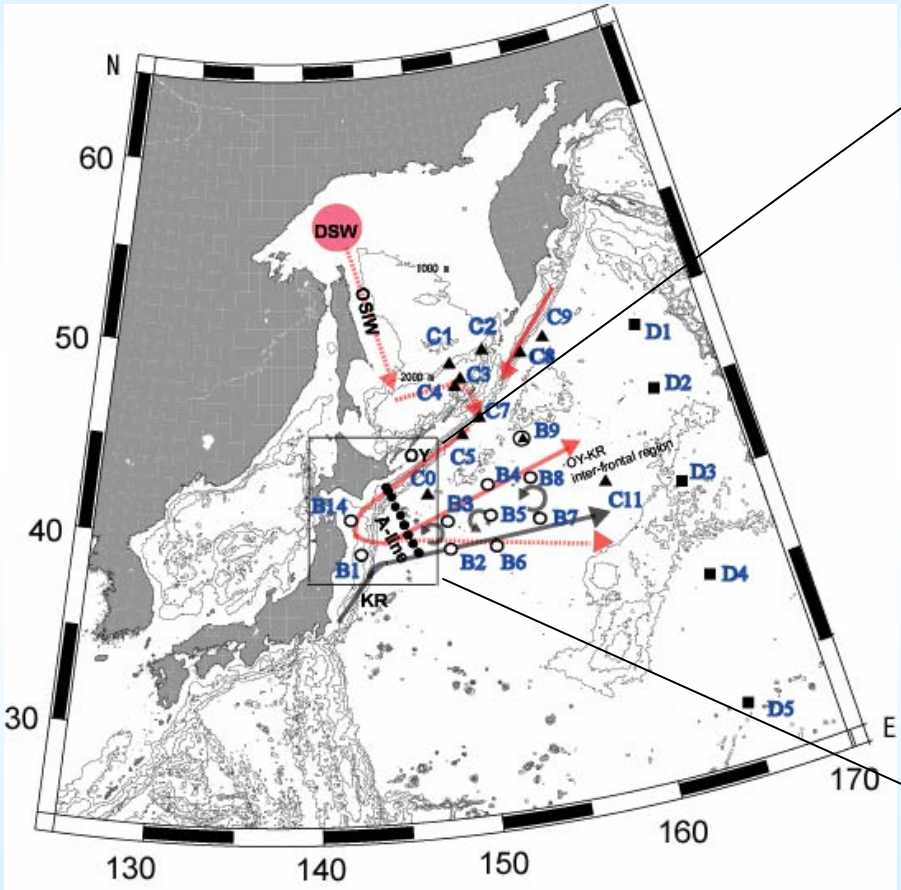
Motivation for this study

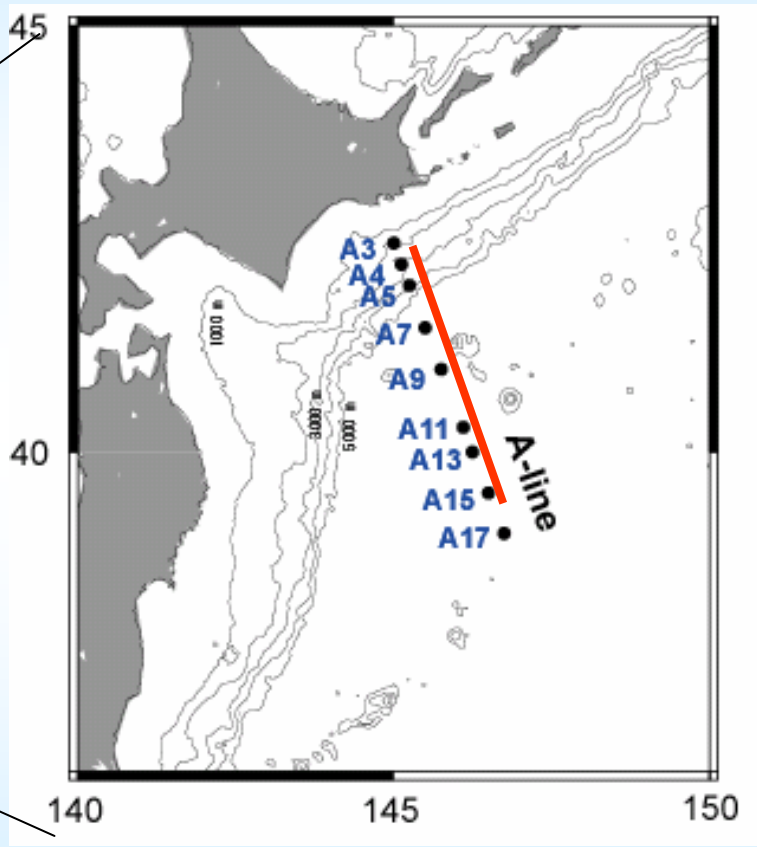
To investigate sources and seasonal timing of iron input…
Time series Fe observation at Oyashio region was conducted from 2003 ~

- Seasonal variability

- What is the driving factor (iron sources, sinks) for the variability

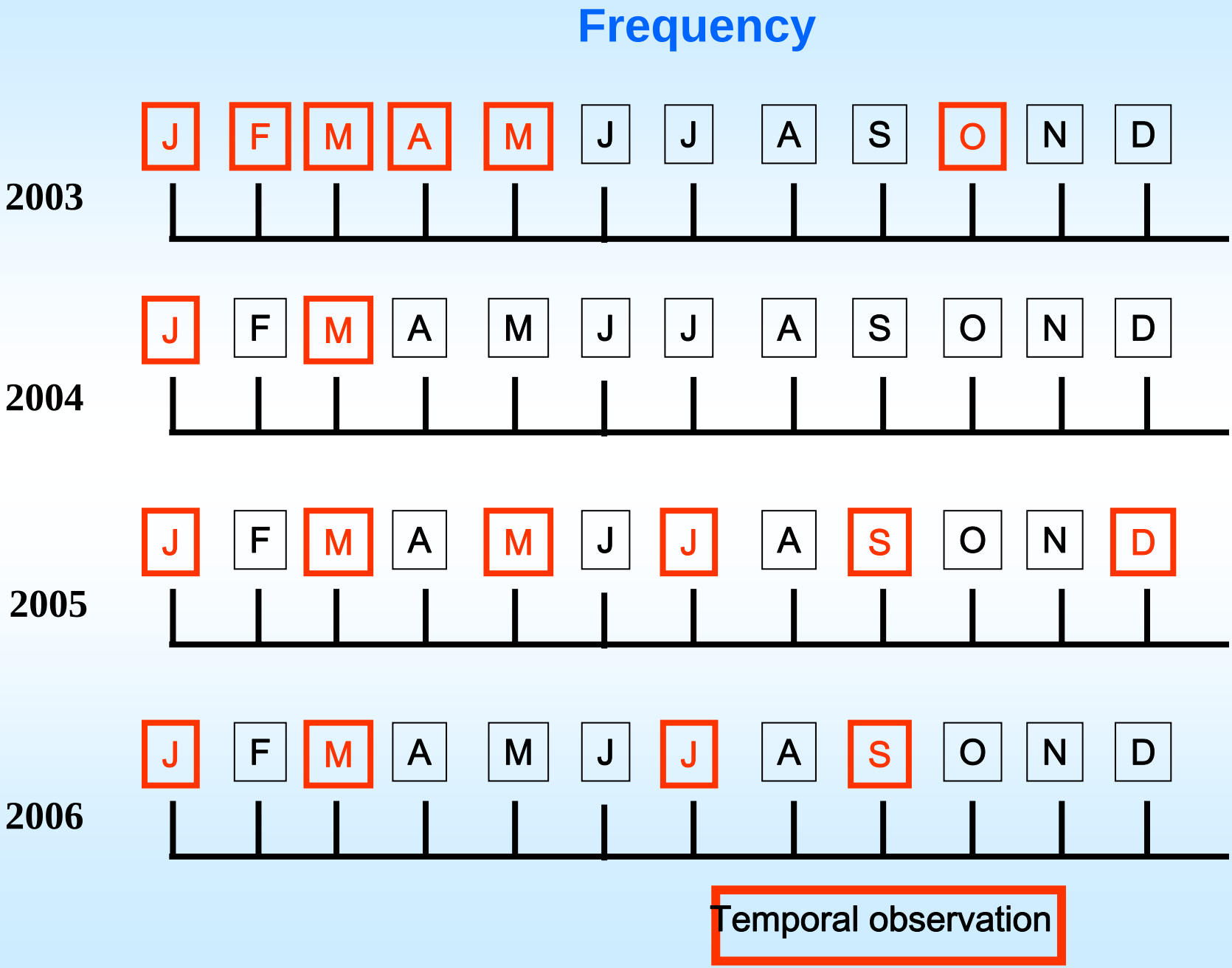
Time series observations for iron concentration along the A line



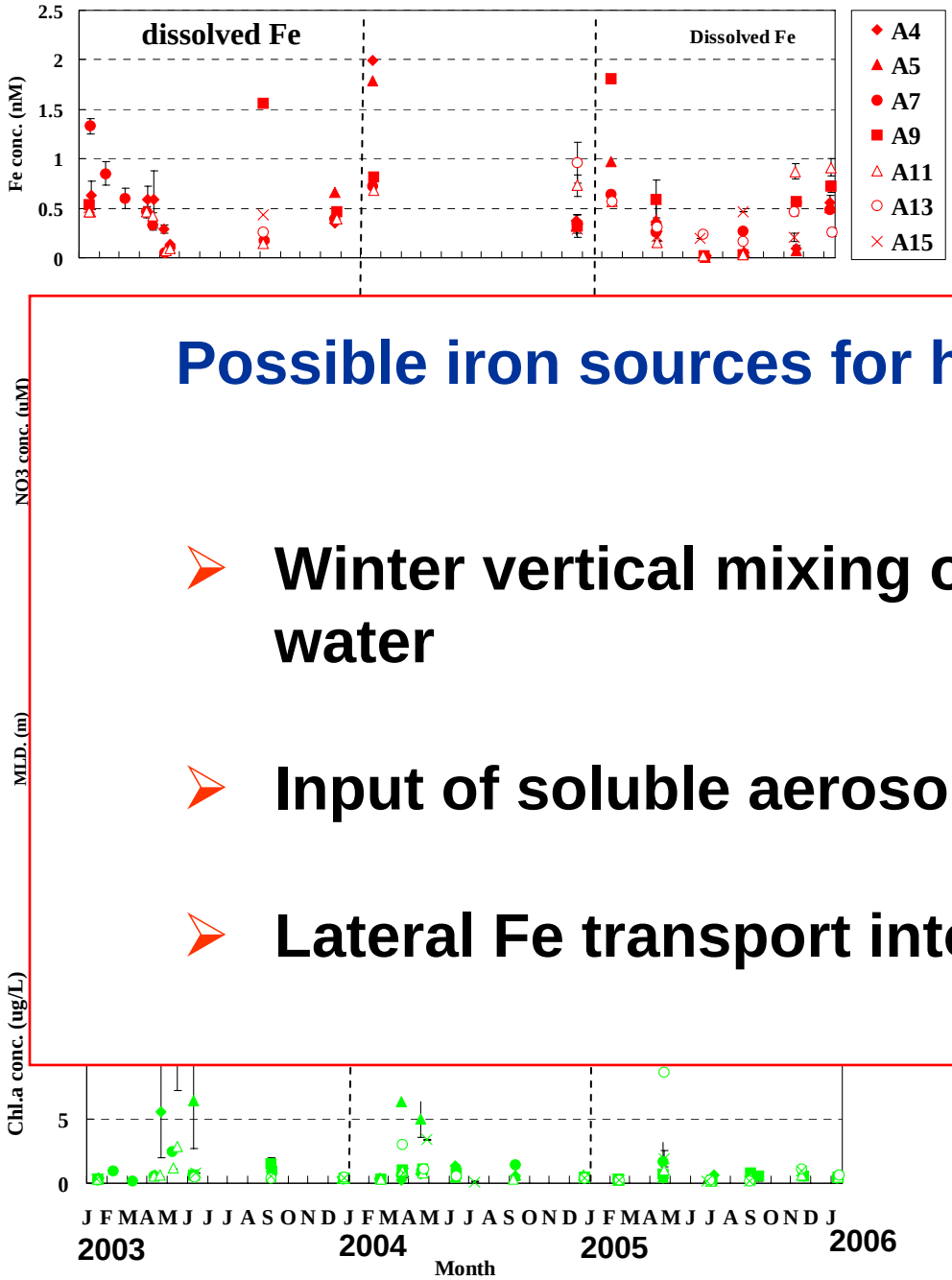


Measurement: Dissolved Fe, Nutrients, Chl.a, Hydrographic data

Time series iron observation in the western subarctic Pacific (WSP)



Results:
Time series data in the surface mixed layer along the A-line



Possible iron sources for high winter dissolved Fe

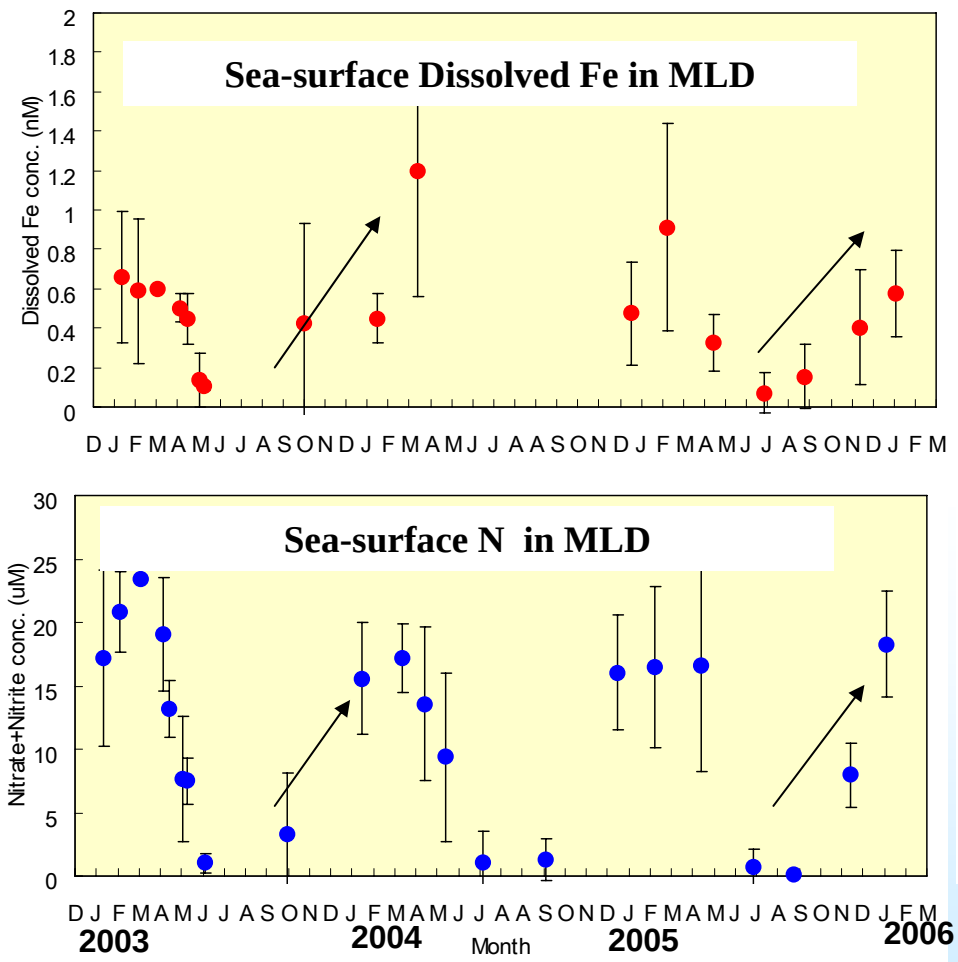
- Winter vertical mixing of Fe-rich subsurface water
- Input of soluble aerosol Fe
- Lateral Fe transport into the surface layer

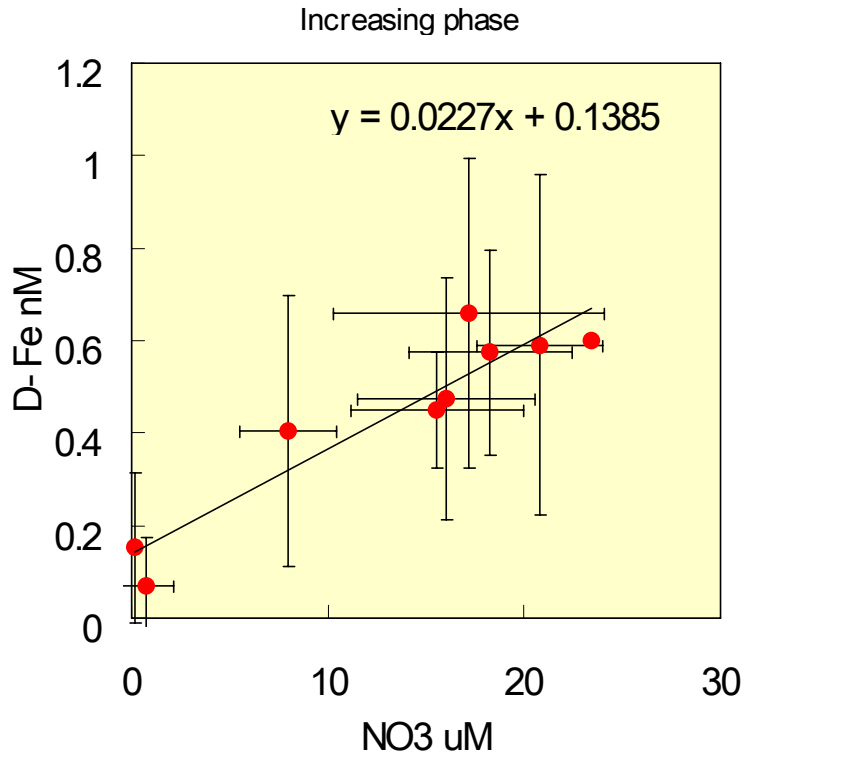
Possible iron sources for high winter dissolved Fe

- **Winter vertical mixing of Fe-rich subsurface water**

Possible iron sources for high winter dissolved Fe

Increasing period



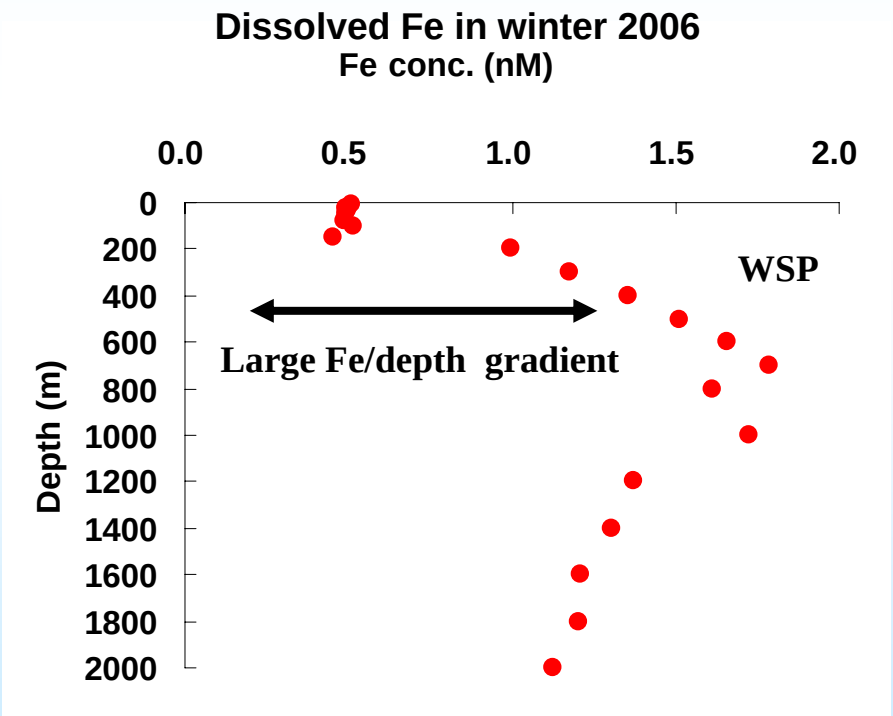


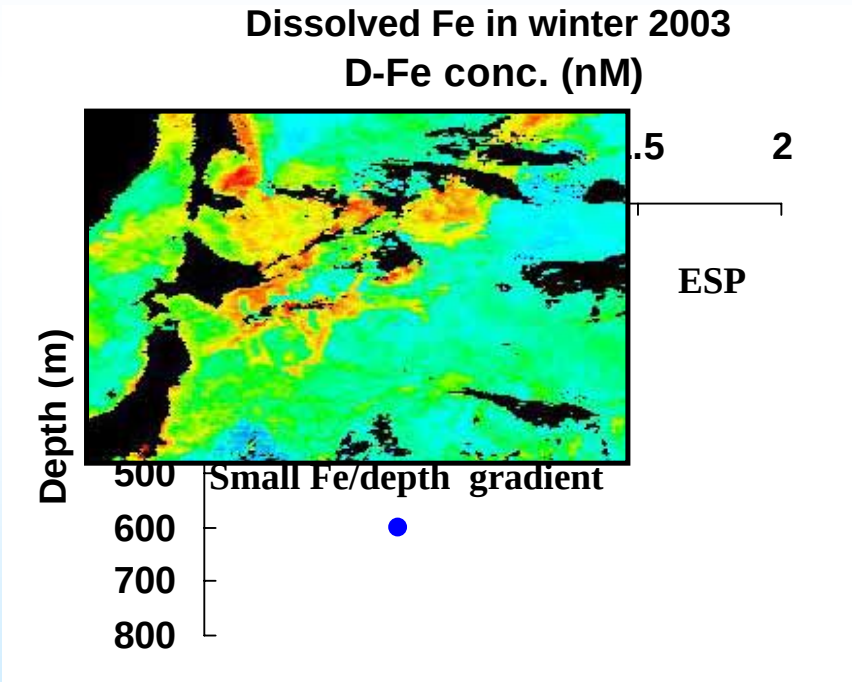
The increase of dissolved Fe is basically driven by winter mixing of sub-surface Fe rich water as same as macro-nutrients.

Comparison to eastern subarctic Pacific (ESP)

	WSP (Oyasyio)	ESP (Papa)
Dis… in sub…		…002
Wint…		…00

Fe supply from the winter vertical mixing cause steady biological production in spring

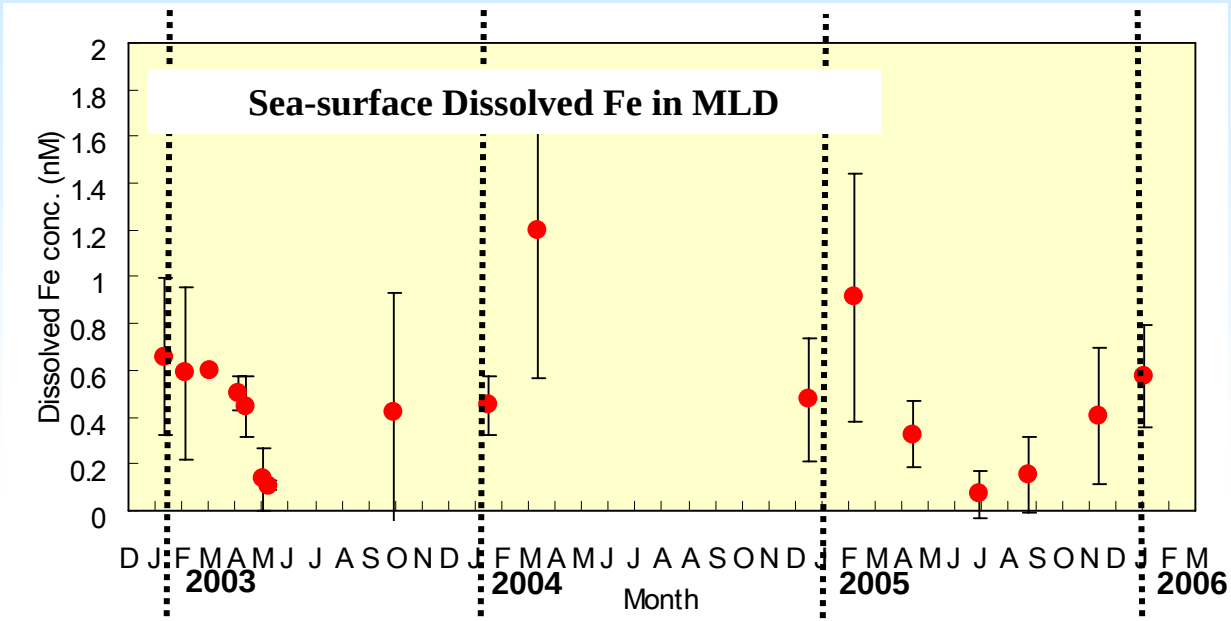


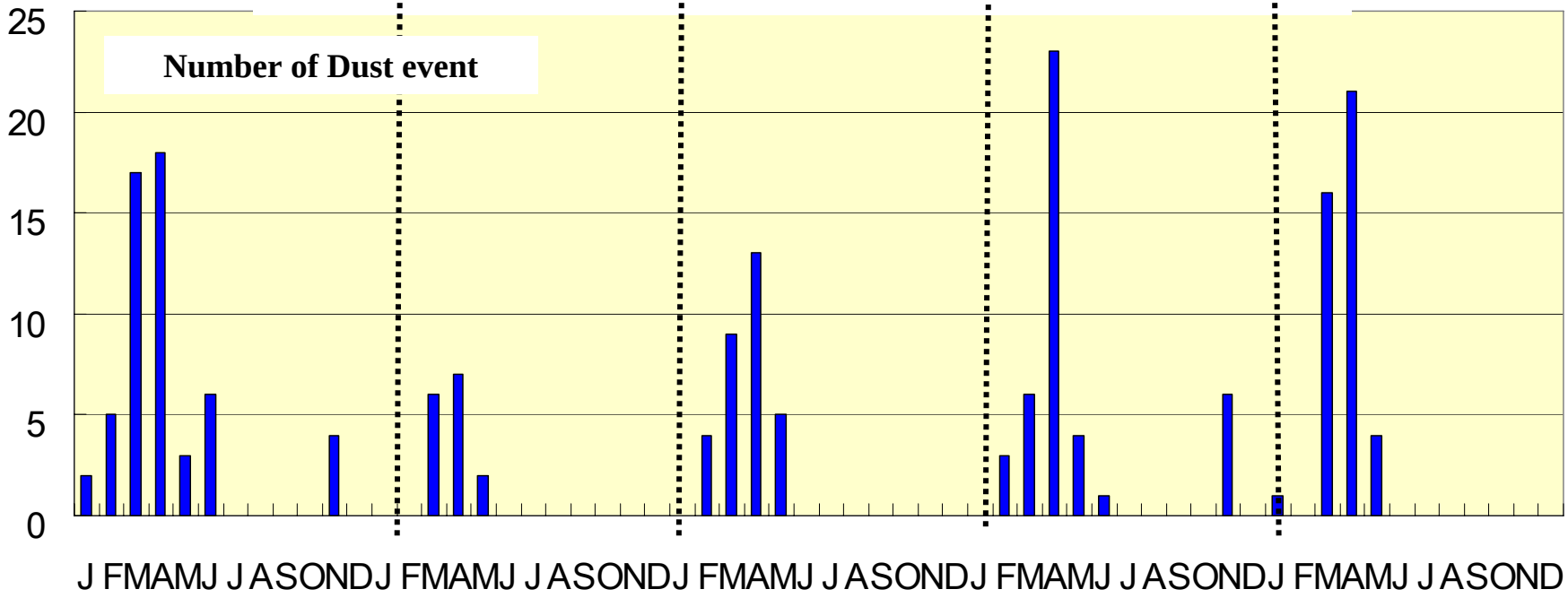


Possible iron sources for high winter dissolved Fe

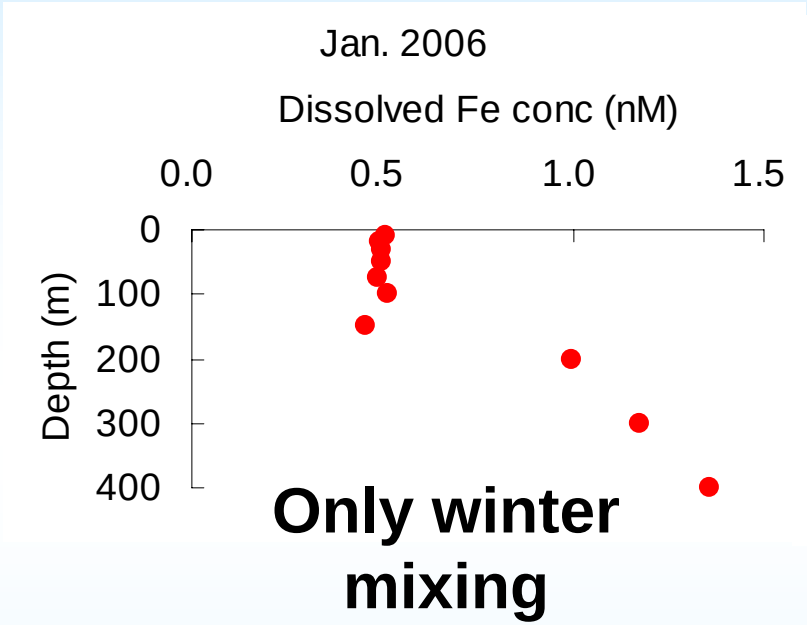
- **Input of soluble aerosol Fe**
- **Lateral Fe transport into the surface layer**

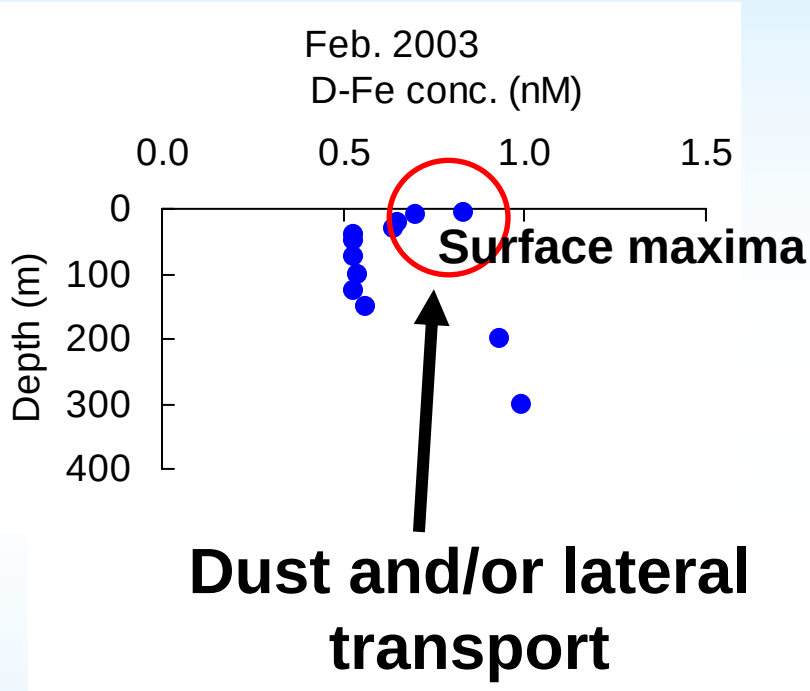
Sea-surface Dissolved Fe vs Number of Dust event





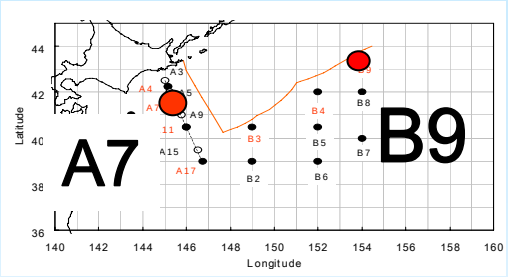
Dust and/or lateral transport Fe supply





Vertical dissolved Fe profile in Jan. 2006 and Feb. 2003

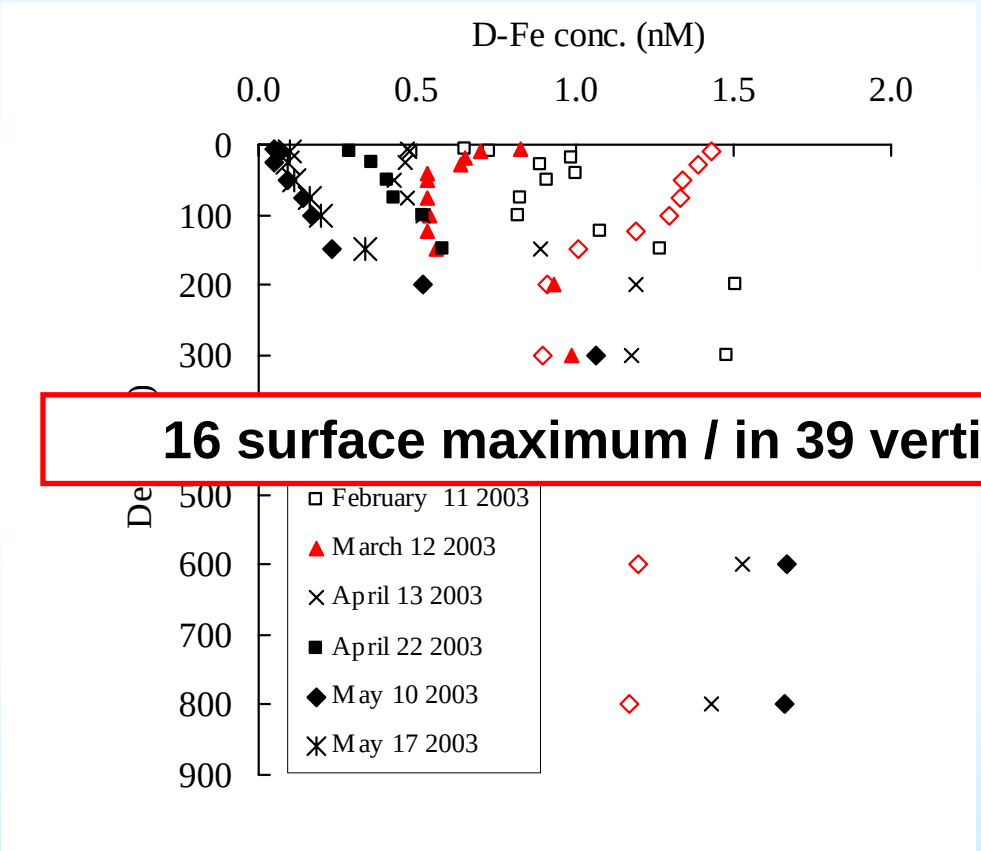
Dust and/or lateral transport Fe supply

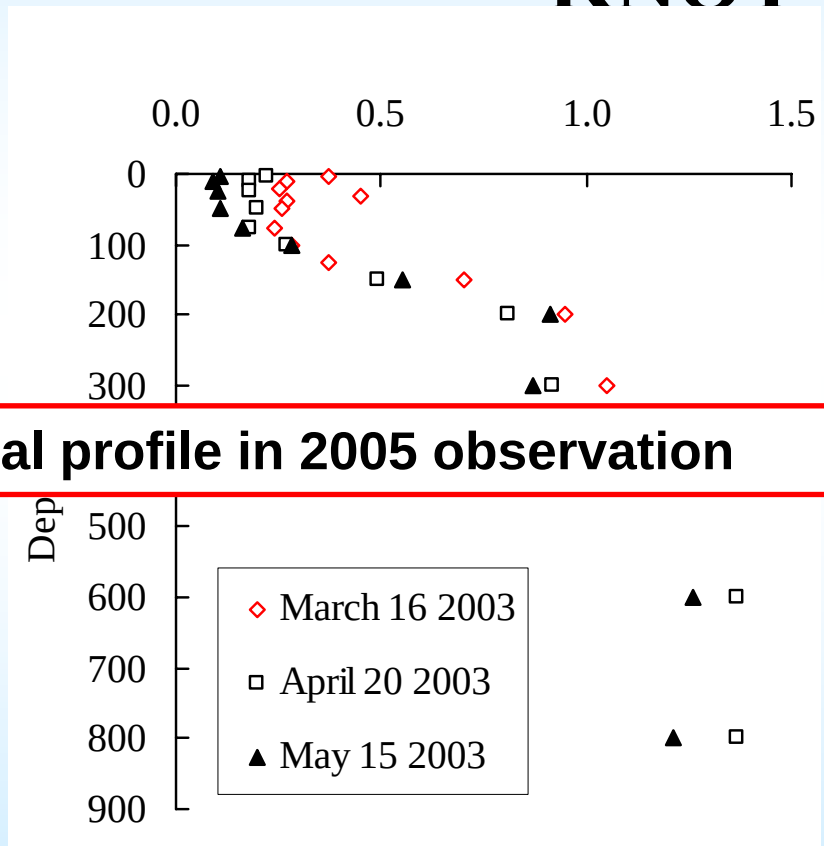


A7

B9

KNOT

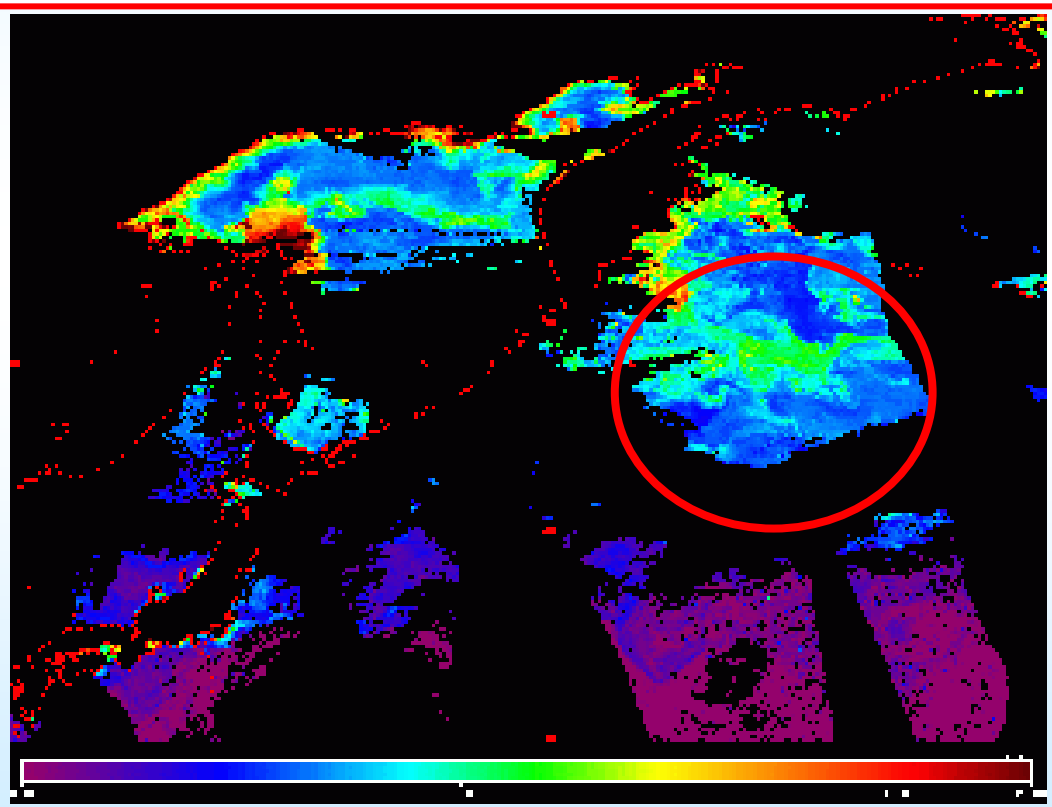




16 surface maximum / in 39 vertical profile in 2005 observation

Dust and/or lateral transport Fe supply

Dust and/or lateral Fe supply may cause sporadic biological production in summer WSP



Chlorophyll_a_concentration by MODIS
July, 2004

Summary

We found clear seasonal variability of dissolved iron concentrations in the surface mixed layer along the *A-line*

The seasonal variation is basically driven by winter mixing of sub-surface Fe rich water and biological Fe uptake in spring bloom

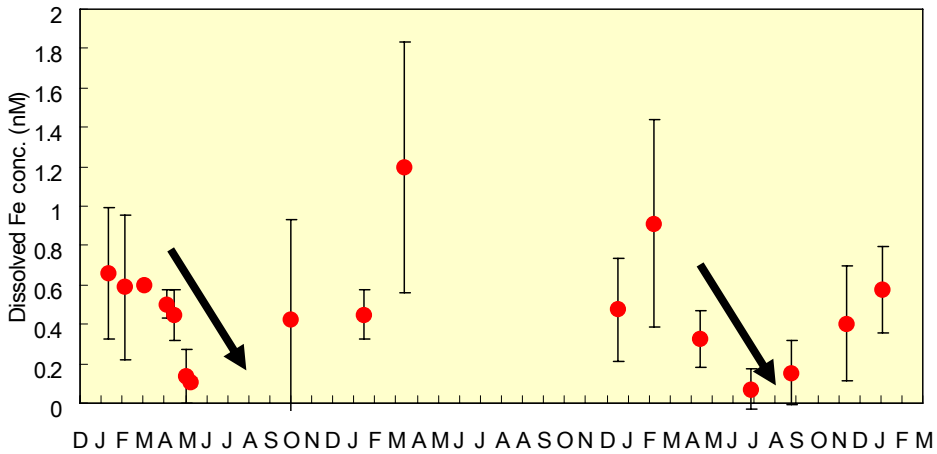
Occasionally, dust and lateral Fe supply caused surface maxima of Fe

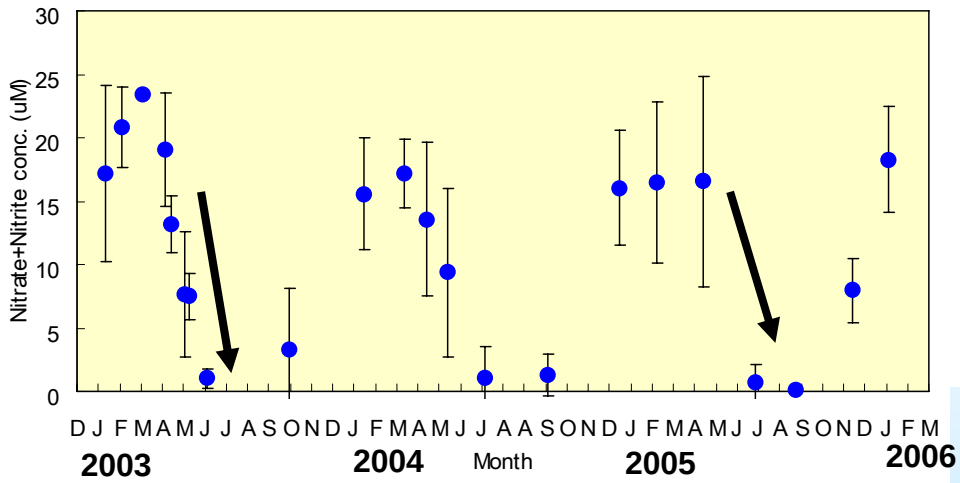
Each source of Fe may have its own impact to biological response…

- ✓ **Fe from below surface: steady spring phytoplankton bloom**
- ✓ **Fe from dust and/or lateral transport: summer sporadic biological production**

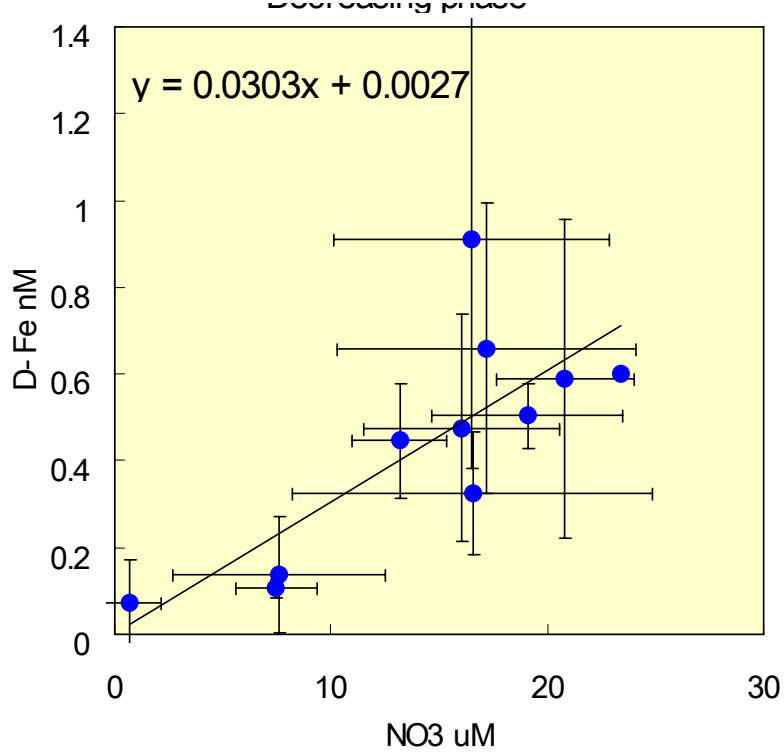
To understand the influence of iron to biological production in the WSP, we have to evaluate each iron sources quantitatively.

Decreasing period





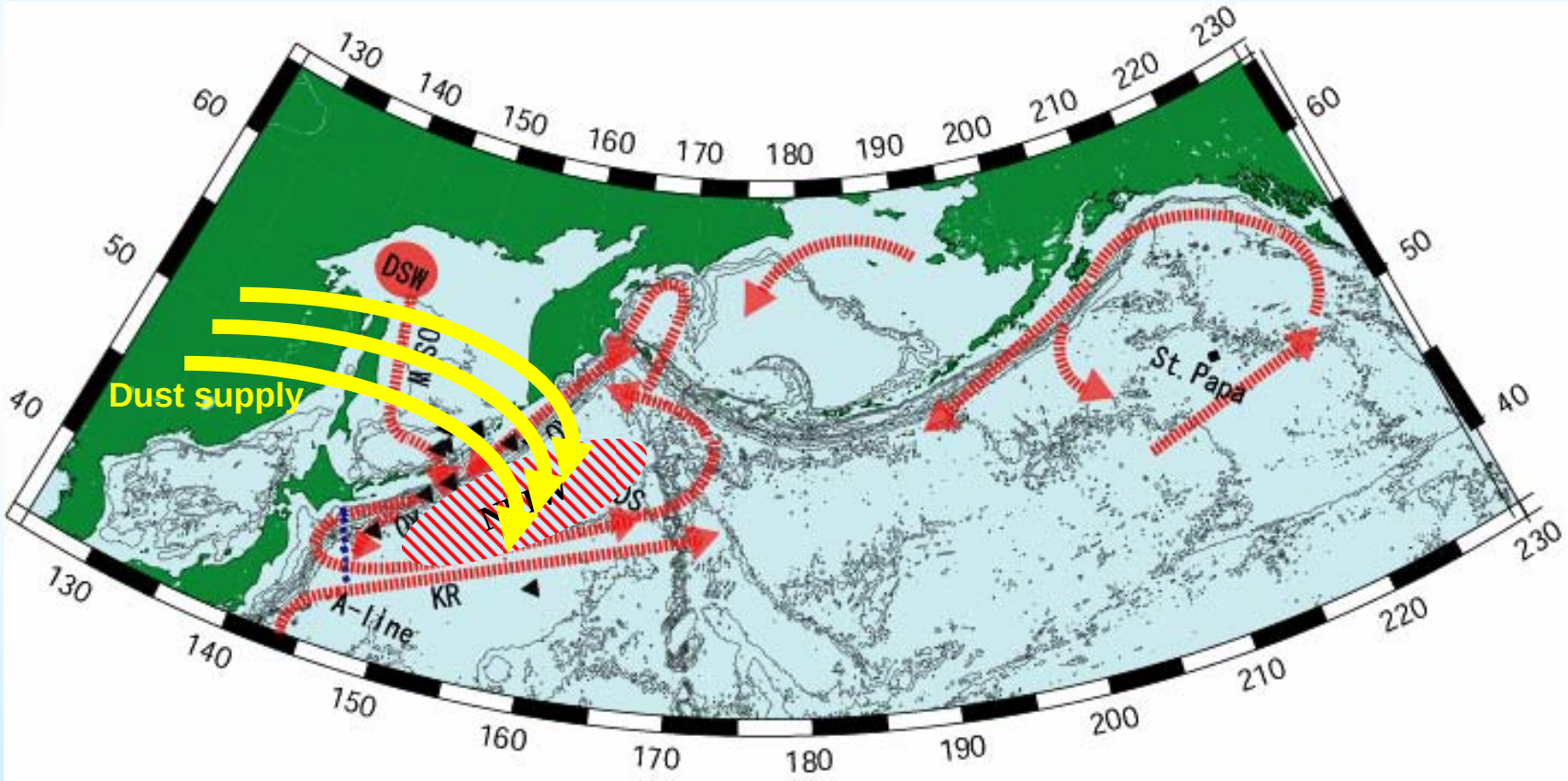
NO_3 vs Dissolved Fe in the dissolved Fe decreasing period (Winter to spring)



The seasonal variation of dissolved Fe is basically driven by winter mixing of sub-surface Fe rich water and biological Fe uptake in spring bloom as same as macro-nutrients

Possible Fe supply processes in the WSP and Oyashio region

- **Fe from dust supply** (Duce and Tindale, 1991, Uematsu et al., 1983)
- **Fe from intermediate water transportation** (Nishioka et al., 2007)



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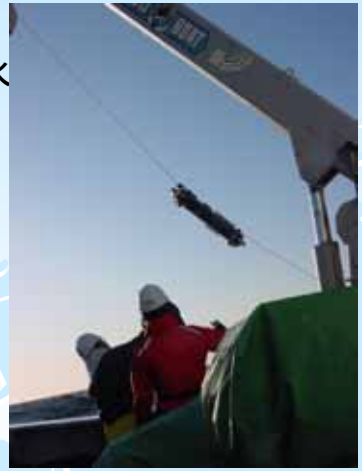
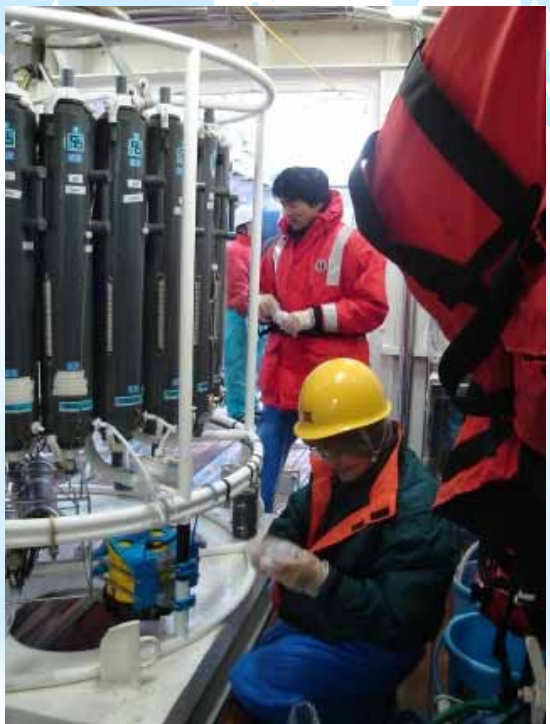
Research Vessels for the time series observation

採水方式

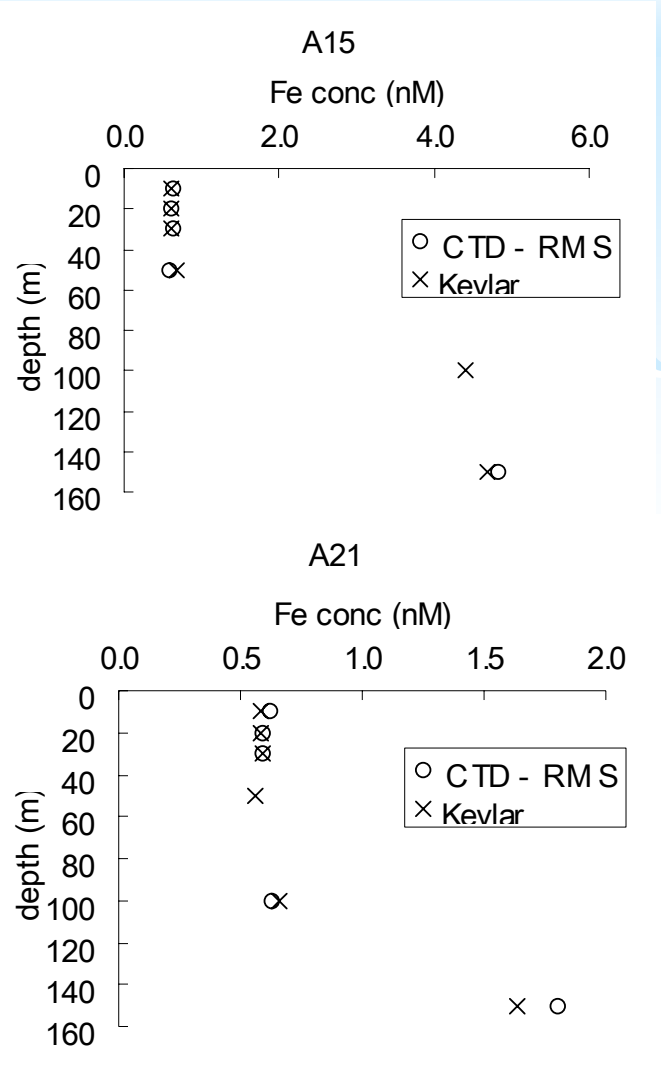
2003/2004.....
ケブラー採水



2005以降....CTD-RMSに
装着したクリーンニスキンによる採水



<CTD採水試料とケブラー採水試料の測定結果比較 >



・ アーマードケーブルの被覆（RMS側20m）
・ RMSフレームのクリーン化
・ （なによりおそらく）システムの新品状態からの
クリーン性の維持

=>通常のCTDシステムからのクリーン採水の実

Time series Fe observation in the western subarctic Pacific (WSP)

Frequency