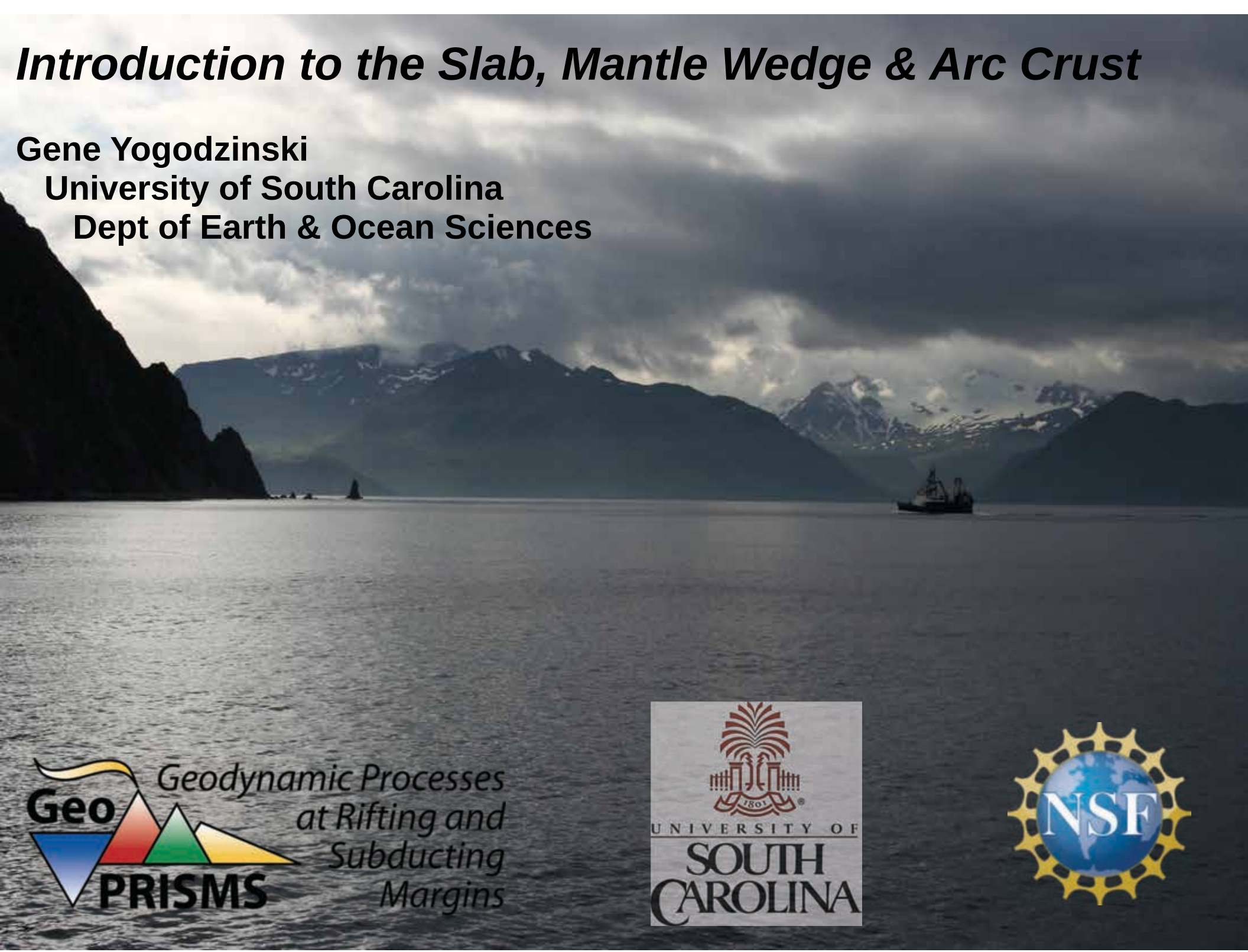
Introduction to the Slab, Mantle Wedge & Arc Crust

Gene Yogodzinski
University of South Carolina
Dept of Earth & Ocean Sciences



GeoPRISMS Geodynamic Processes at Rifting and Subducting Margins

UNIVERSITY OF SOUTH CAROLINA

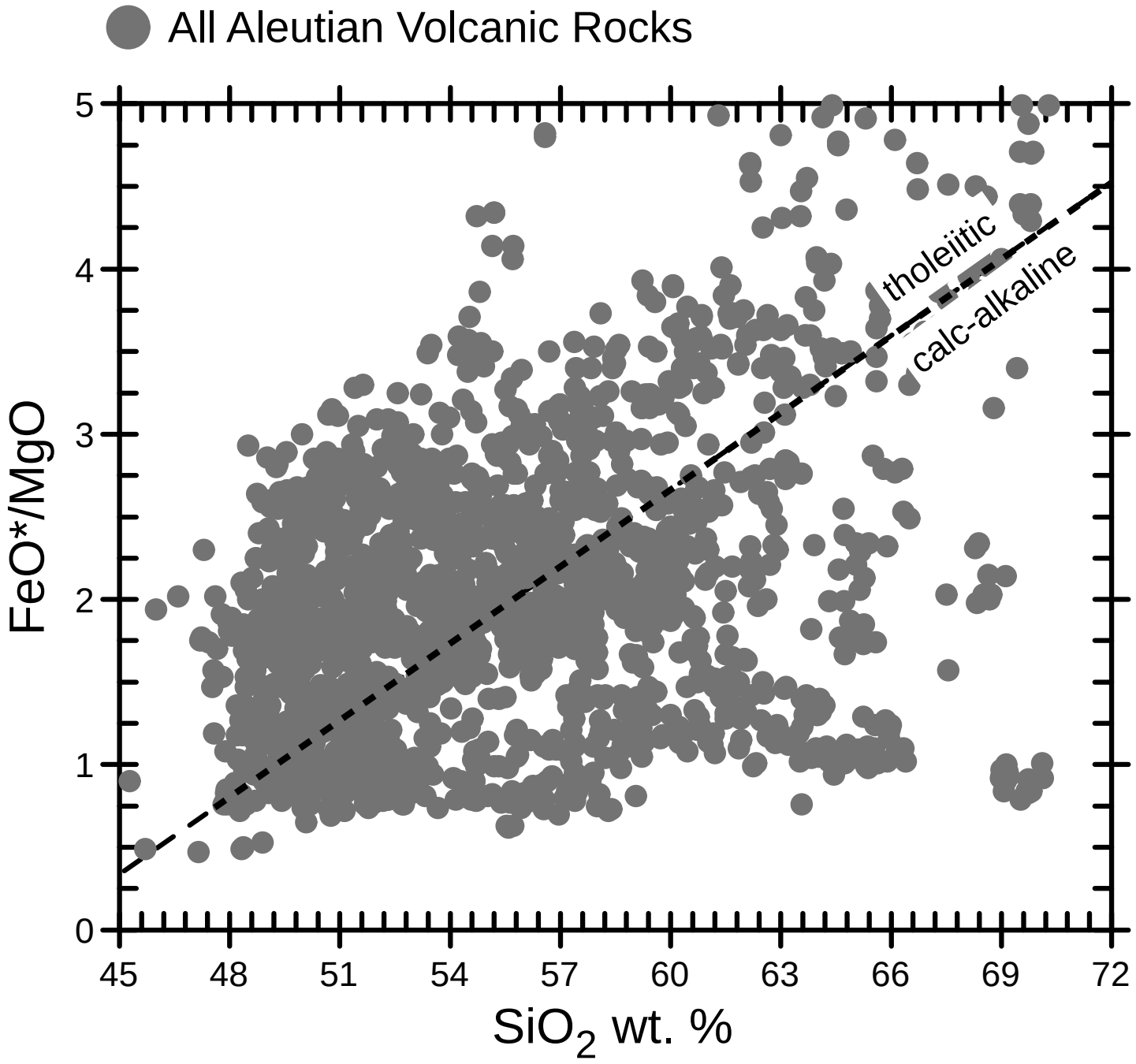
NSF

Questions for This Talk

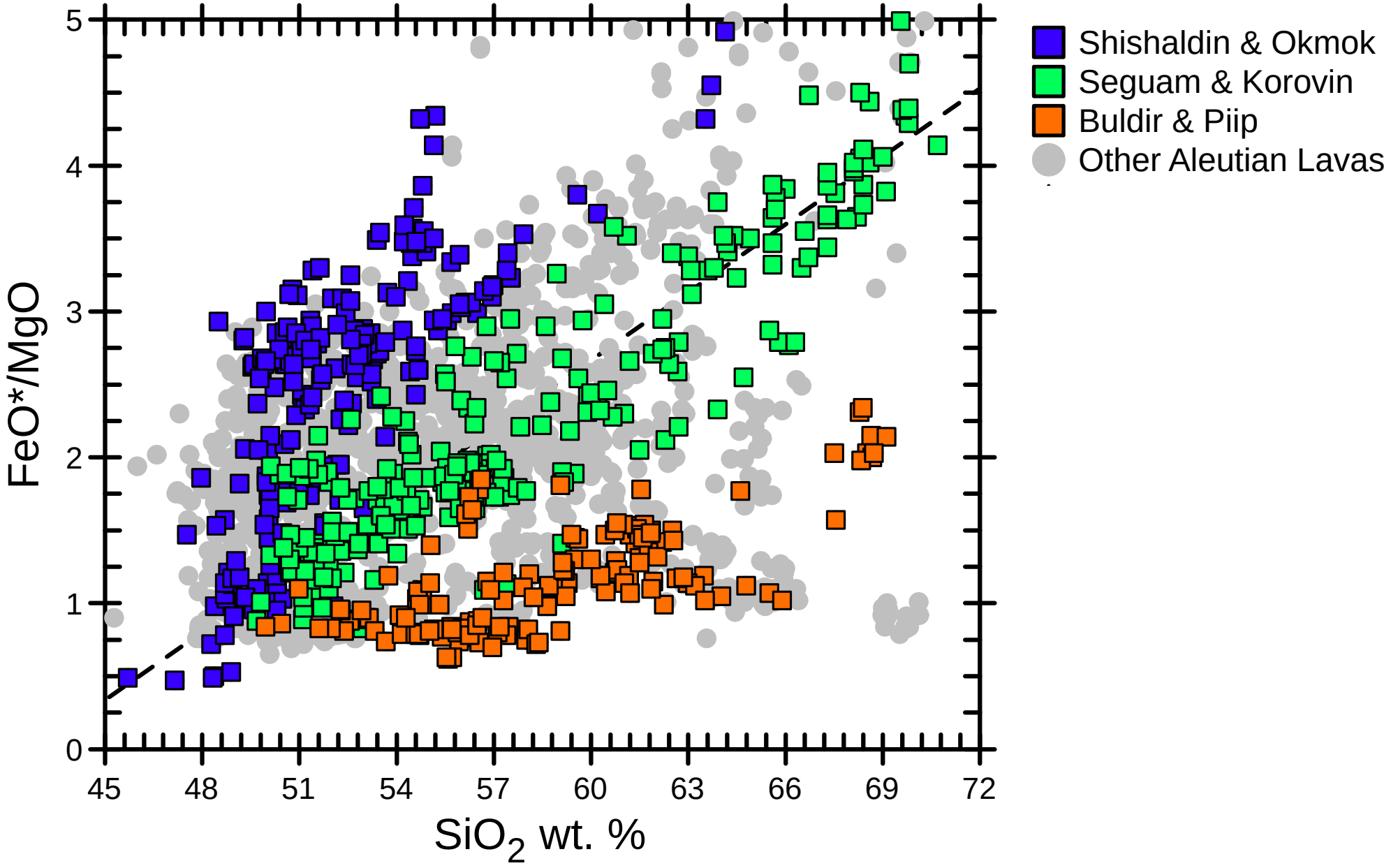
What is calc-alkaline magmatism?
What causes it?
Why does it matter?

Where (exactly) does the water come from?

What is the nature of island-arc crust?
Is it geochemically / geophysically like continental crust?



Discriminant line for tholeiitic / calc-alkaline igneous series from Miyashiro (1974)



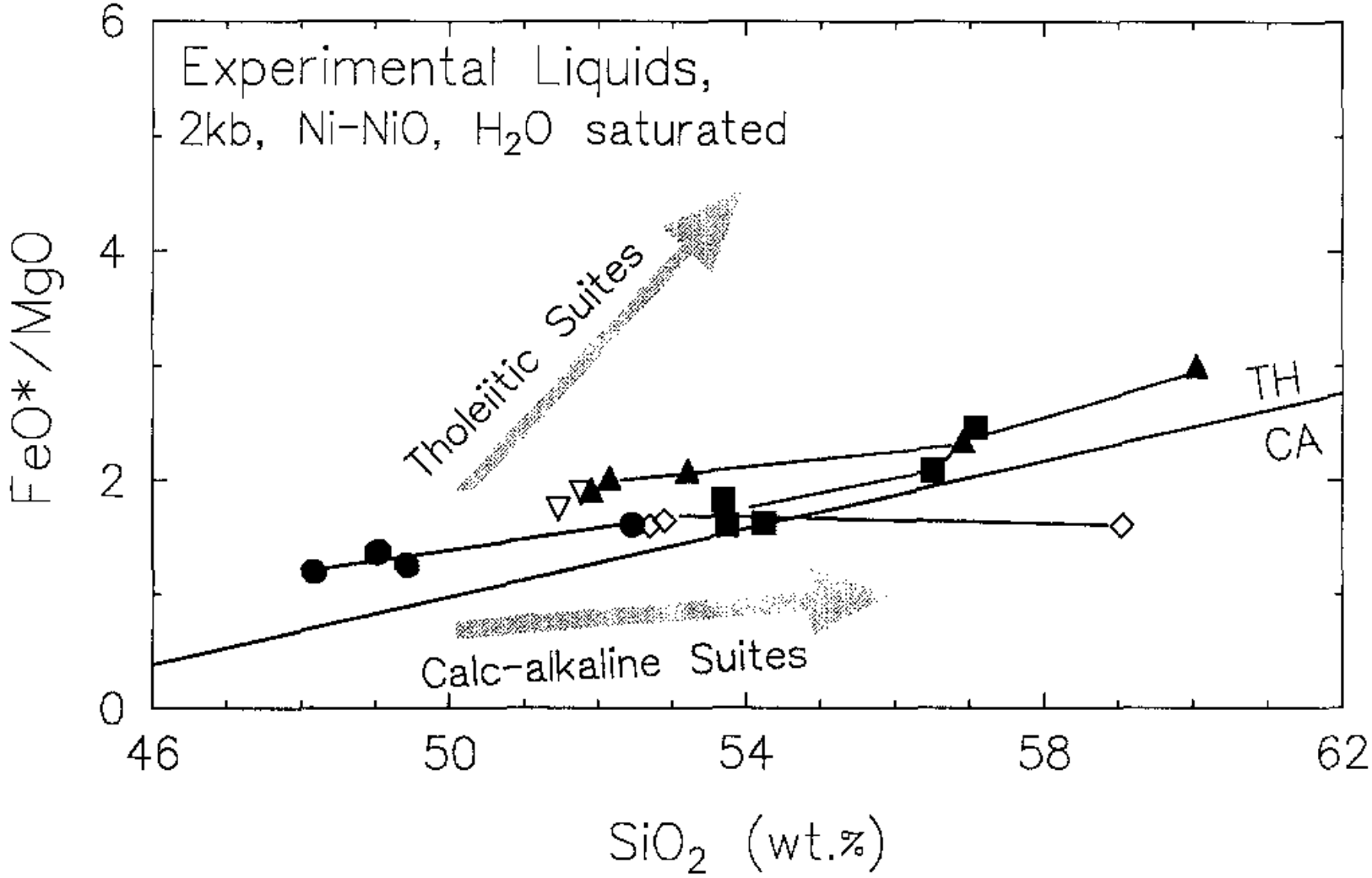
TH vs CA line from Miyashiro (1974)

Experimental investigations of the role of H_2O in calc-alkaline differentiation and subduction zone magmatism

T.W. Sisson* and T.L. Grove

Earth, Atmospheric, and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, MA 02138, USA

Contrib Mineral Petrol (1993) 113:143–166

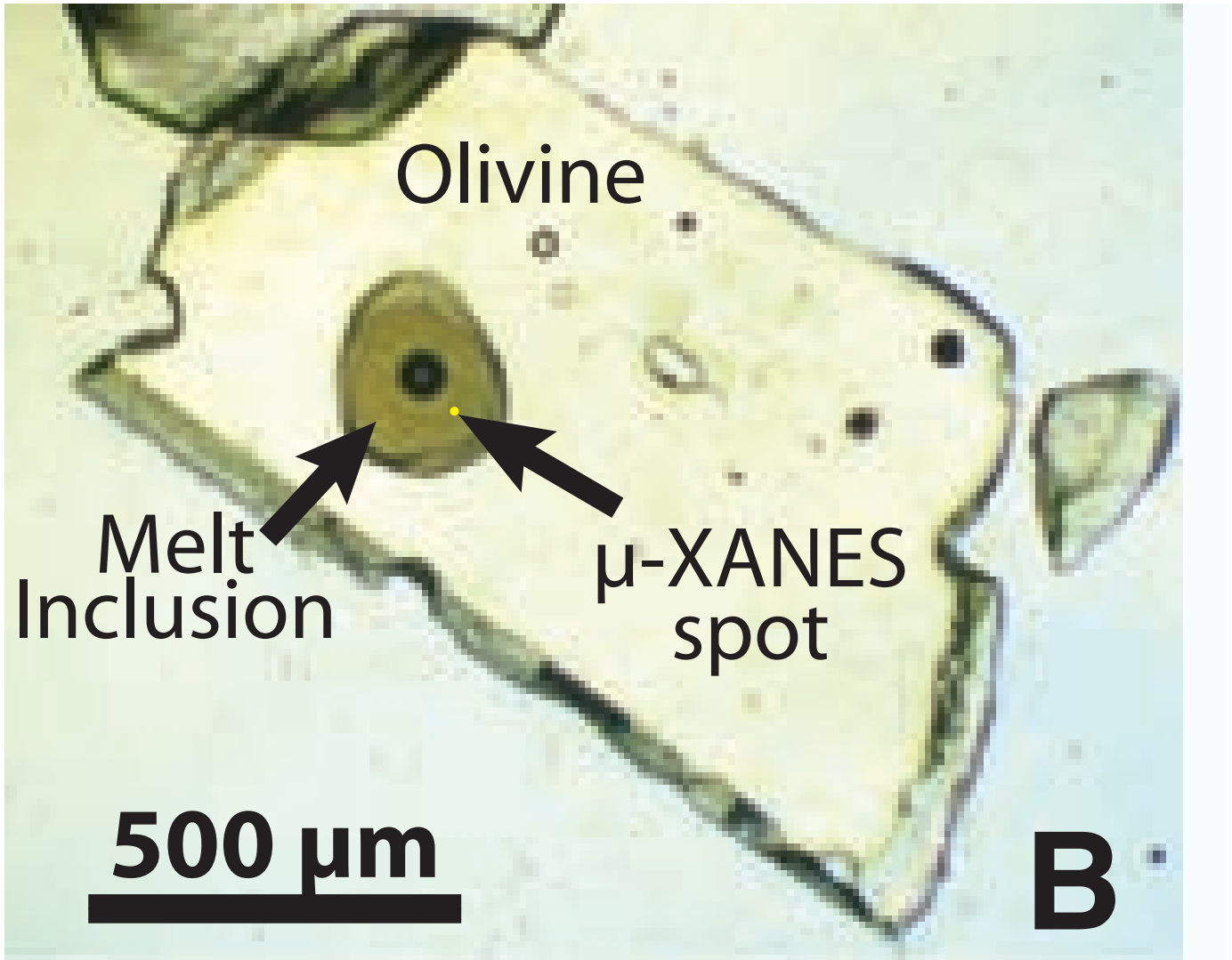



https://www.avo.alaska.edu/

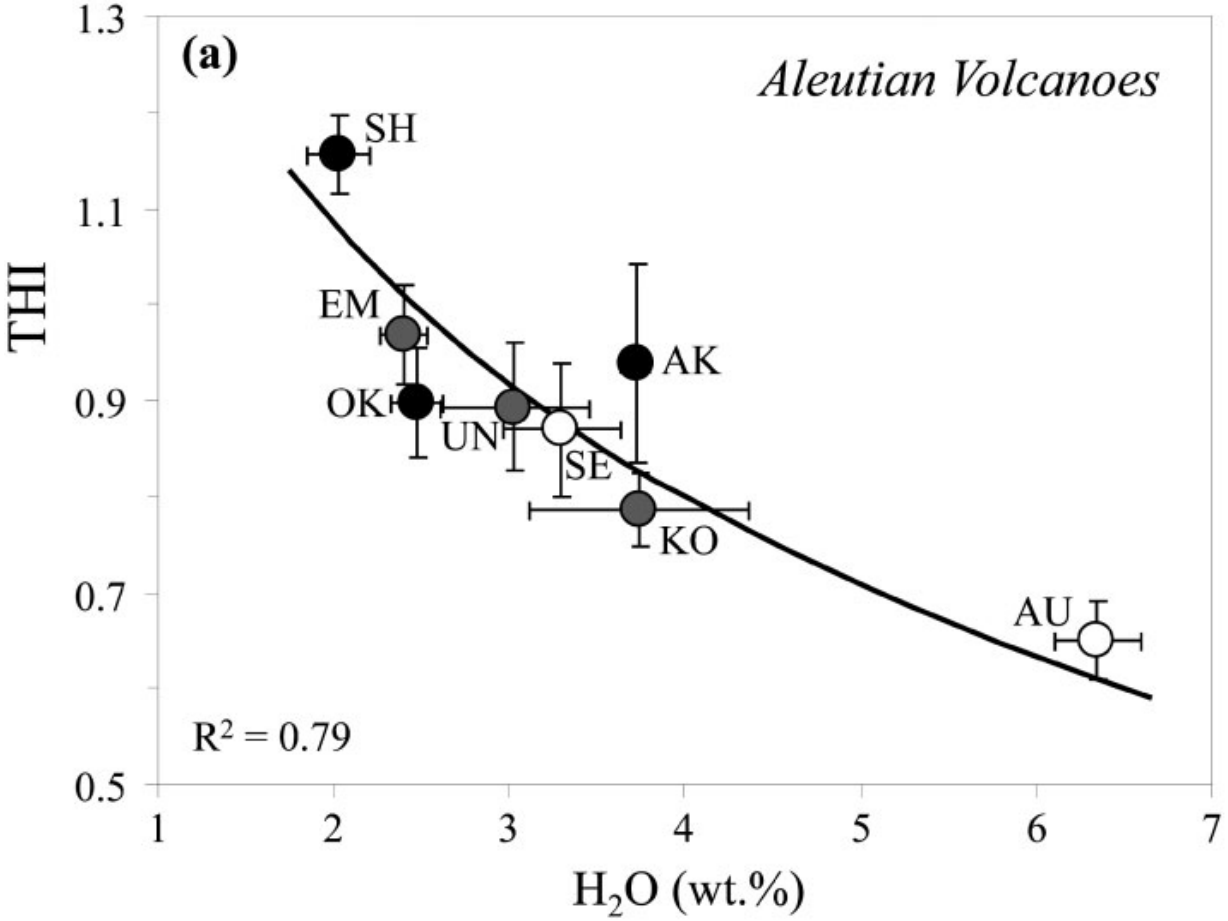
Water and the Oxidation State of Subduction Zone Magmas

Katherine A. Kelley[1]*† and Elizabeth Cottrell[2]*

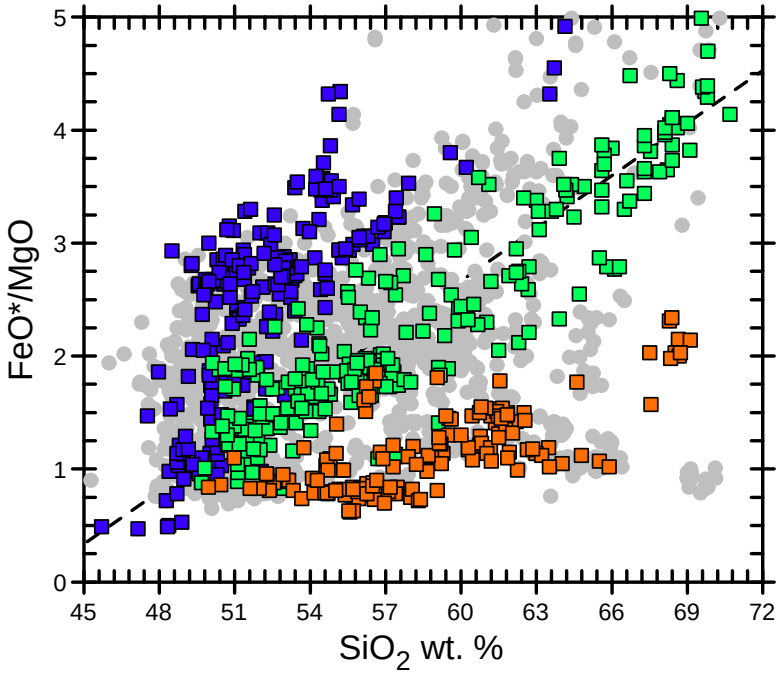
Kelly & Cottrell (2009 - *Science*)



Zimmer et al. (2010 - *J. of Petrology*)



Shishaldin & Okmok
Seguam & Korovin
Buldir & Piip
Other Aleutian Lavas



ELSEVIER

Earth and Planetary Science Letters 183 (2000) 27–41

EPSL

www.elsevier.com/locate/epsl

Open system behavior of olivine-hosted melt inclusions

Glenn A. Gaetani *, E. Bruce Watson

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Received 27 October 1999; received in revised form 16 August 2000; accepted 31 August 2000

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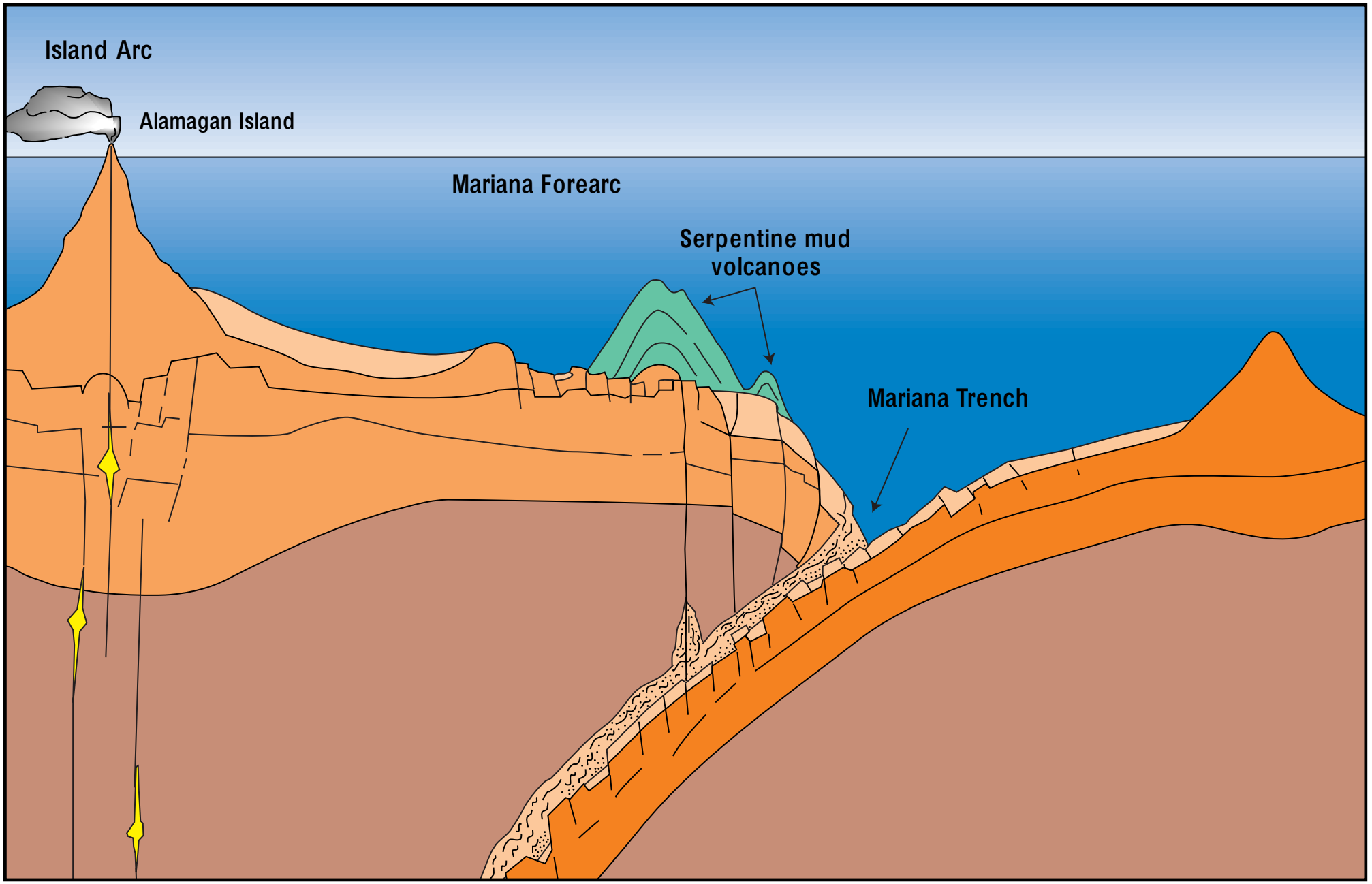
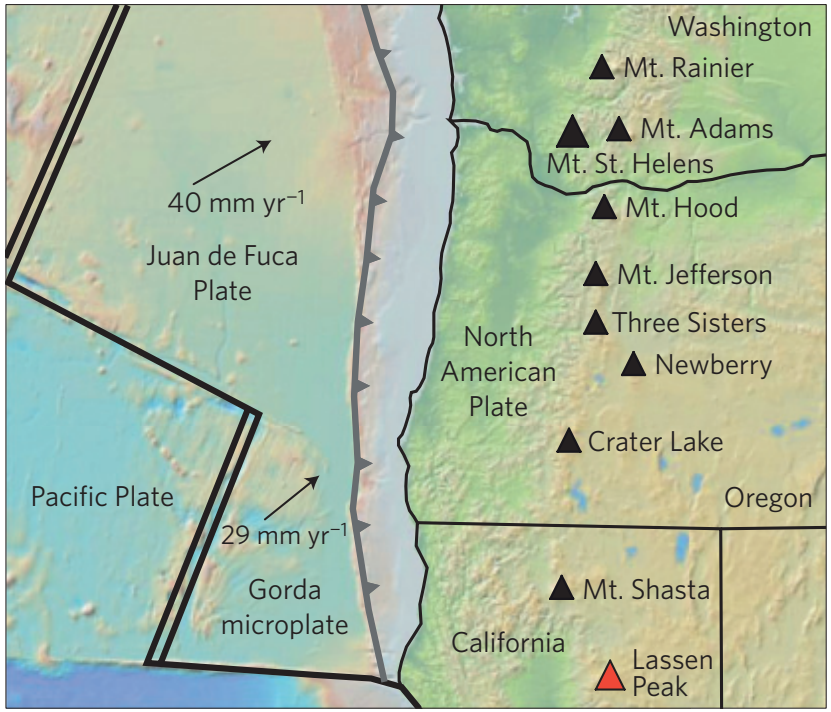
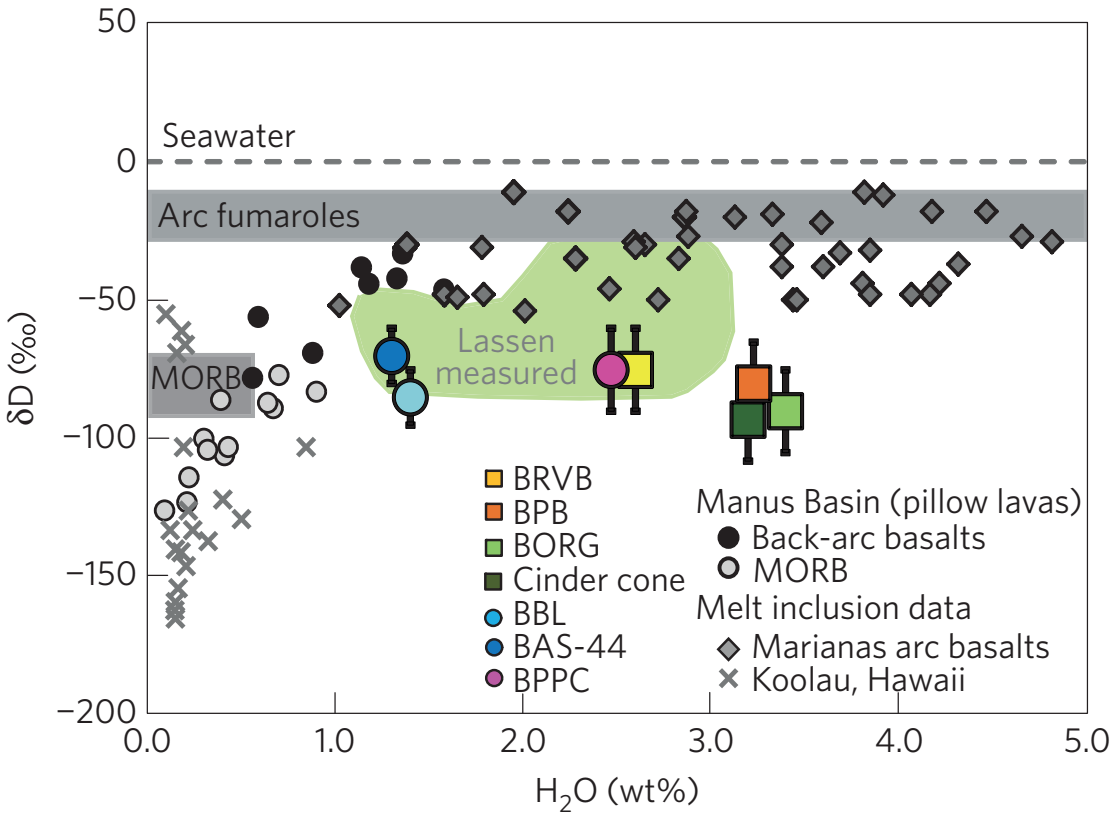
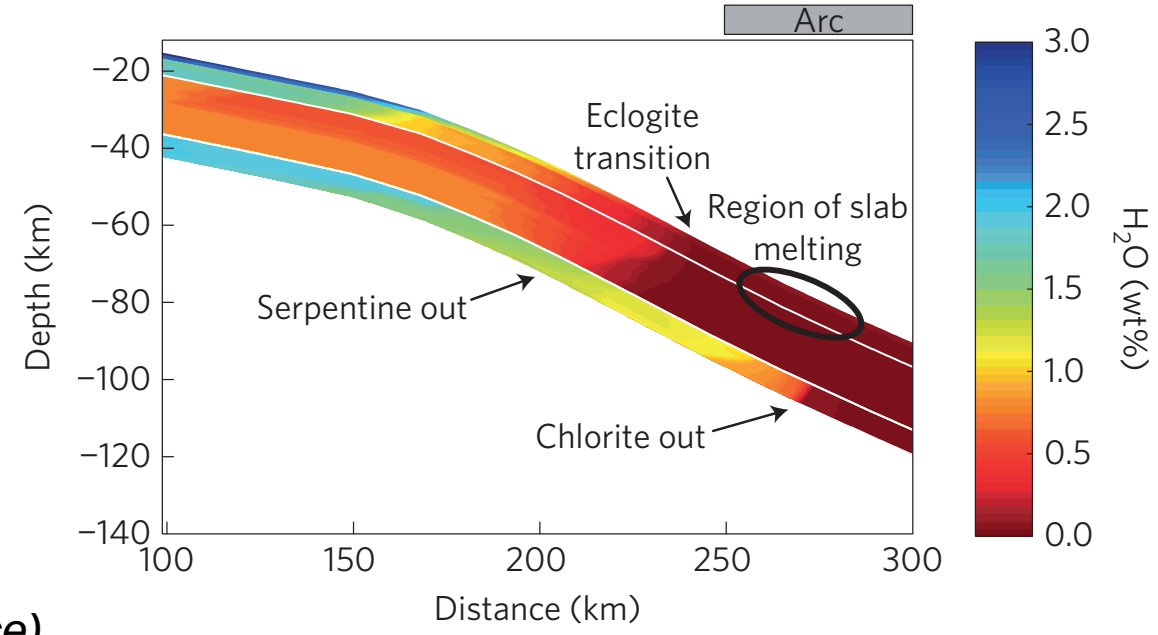


http://odplegacy.org/PDF/Outreach/Brochures/Greatest_Hits/Margins/Fryer.pdf







Walowski et al. (2015 - *Nature GeoScience)*

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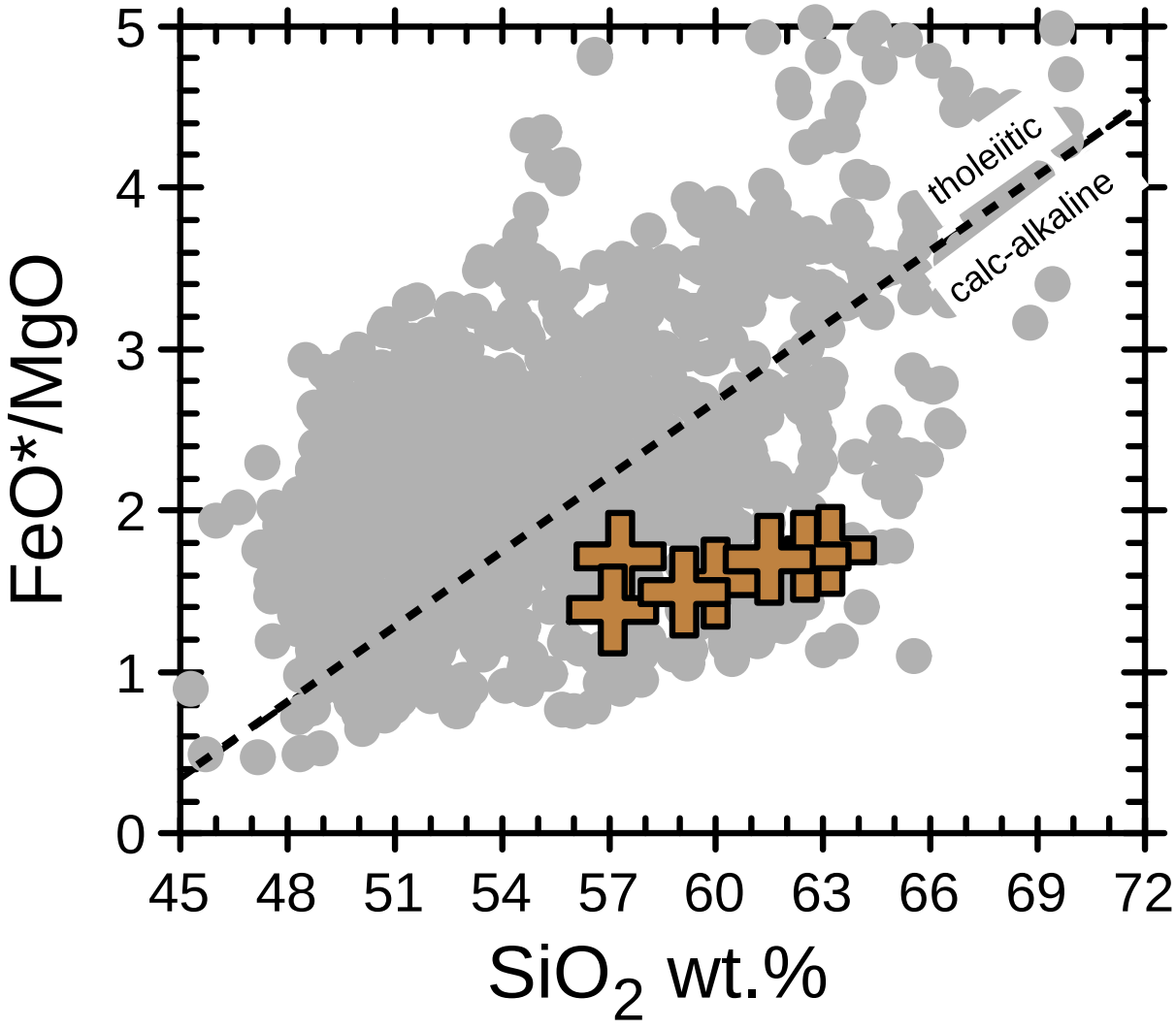
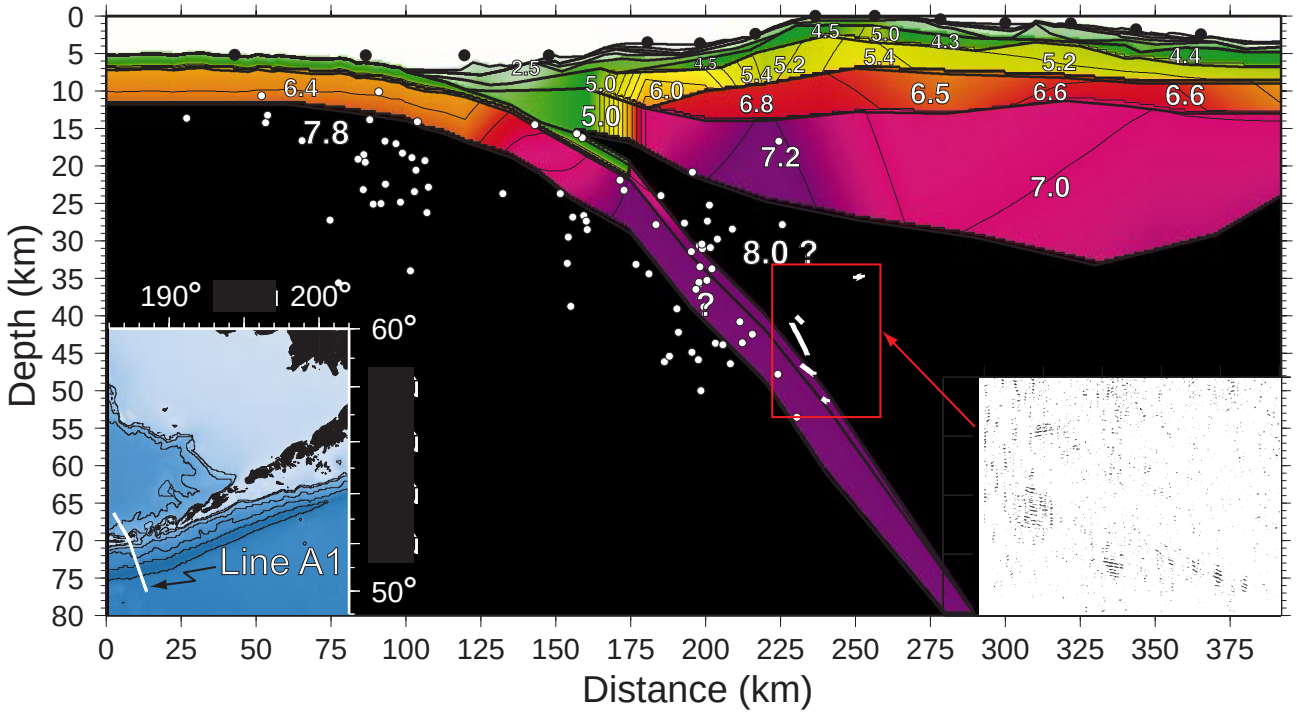


Aleutian Emergent Volcanoes
Bulk Continental Crust

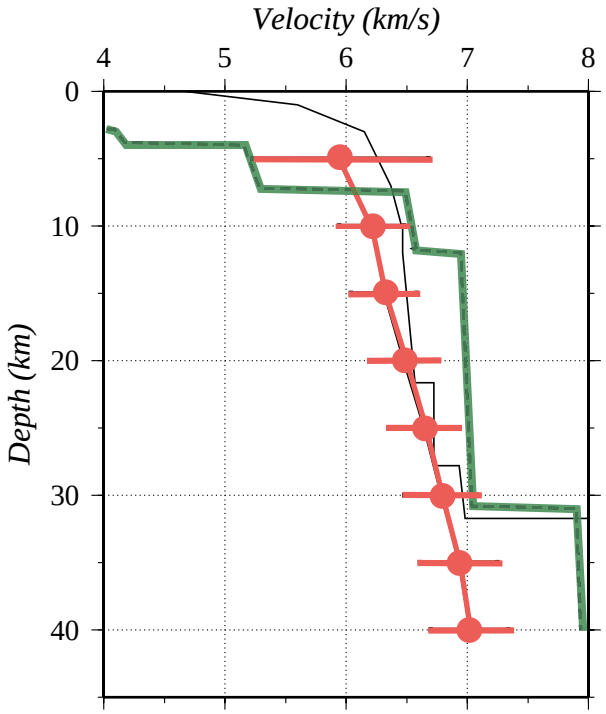
Continental Crust Estimates
Rudnick & Fountain (1995)
Wedepohl (1995)
Taylor & McLennan (1985)
Weaver & Tarney (1984)
Holland & Lambert (1972)
Pakiser & Robinson (1966)

TH vs CA line from Miyashiro (1974)



Holbrook et al. (1999 - *Geology*)

see also
Kodaira et al. (2007 - *Geology*)

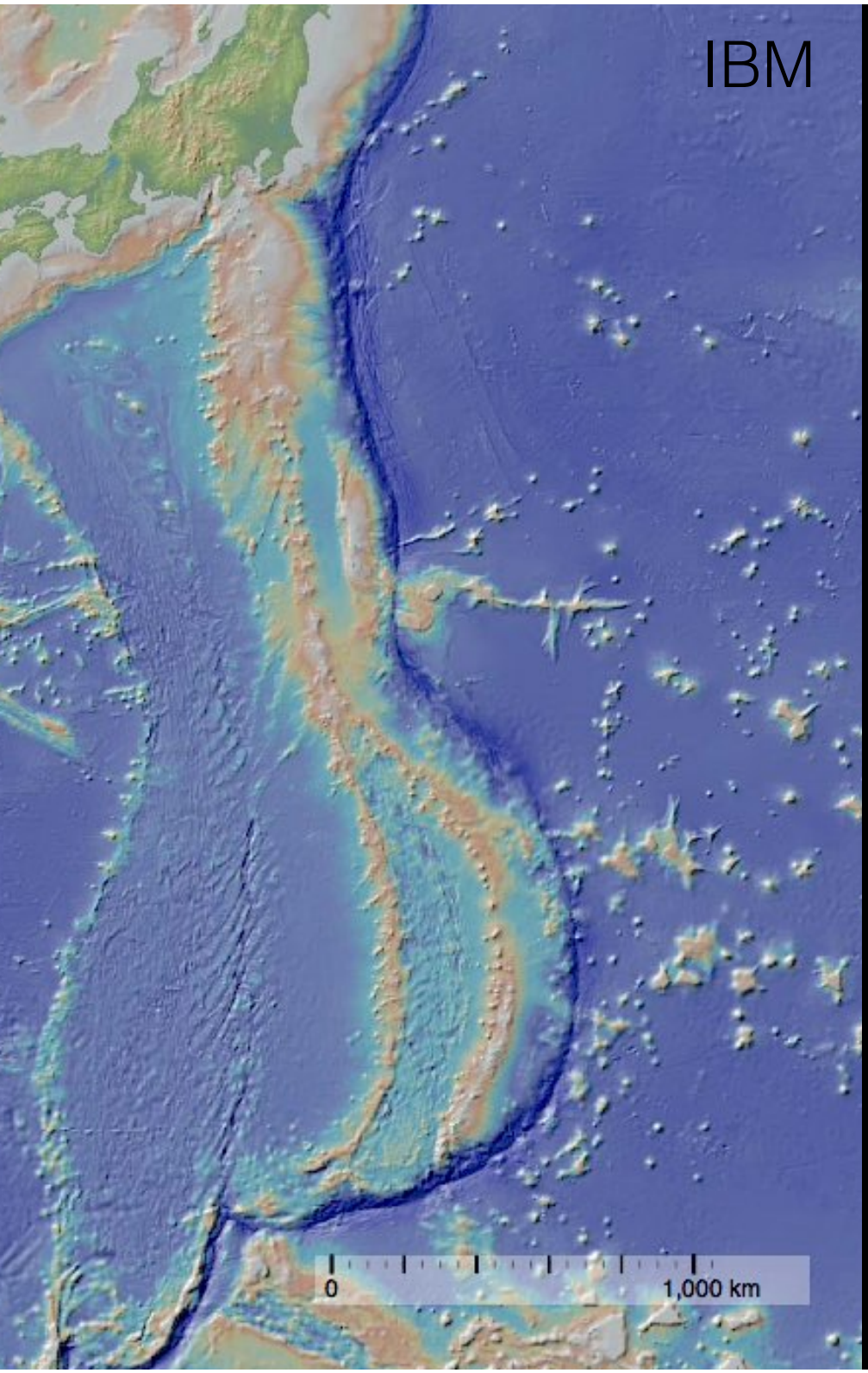


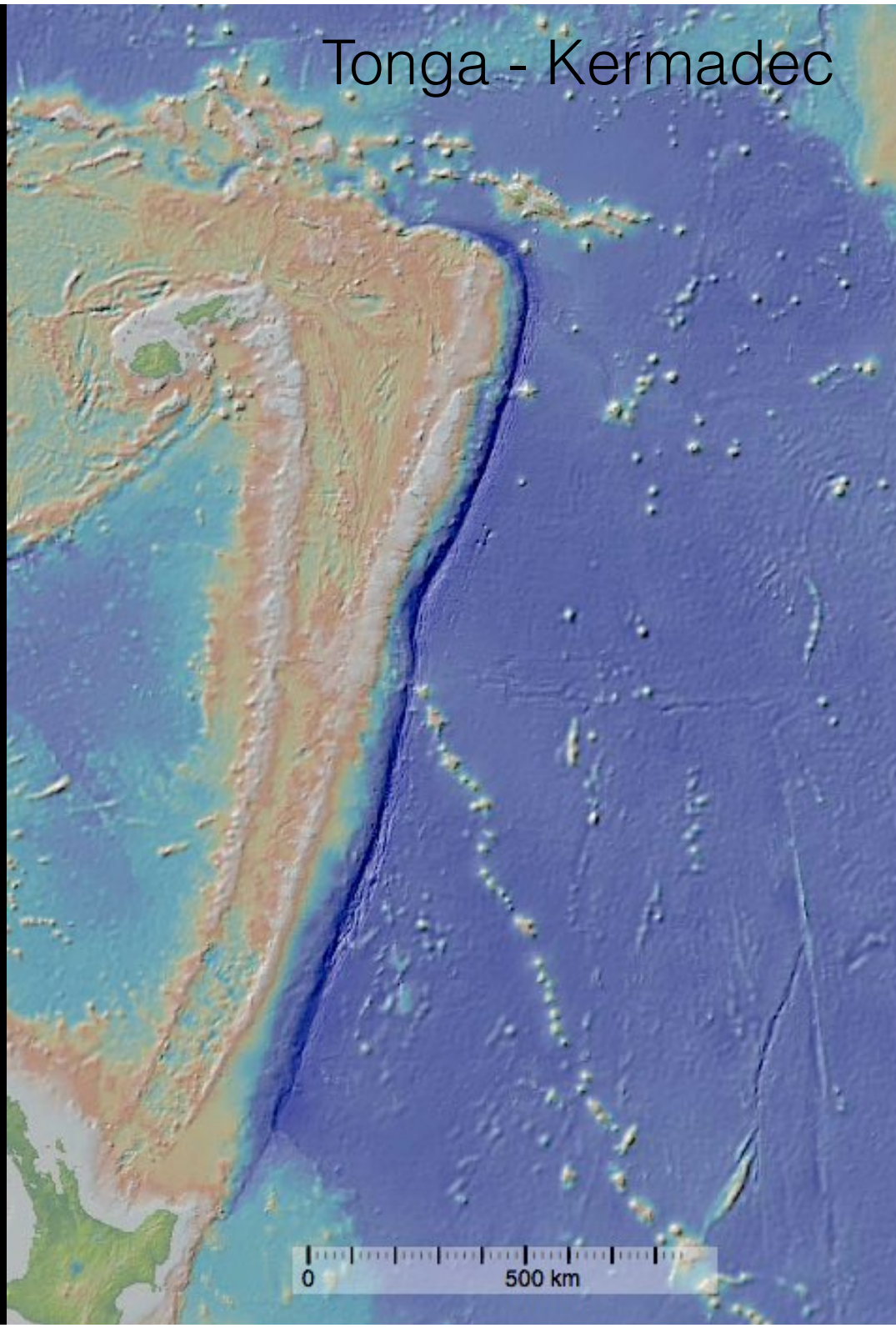
Average Continents - Christensen & Mooney (1995)

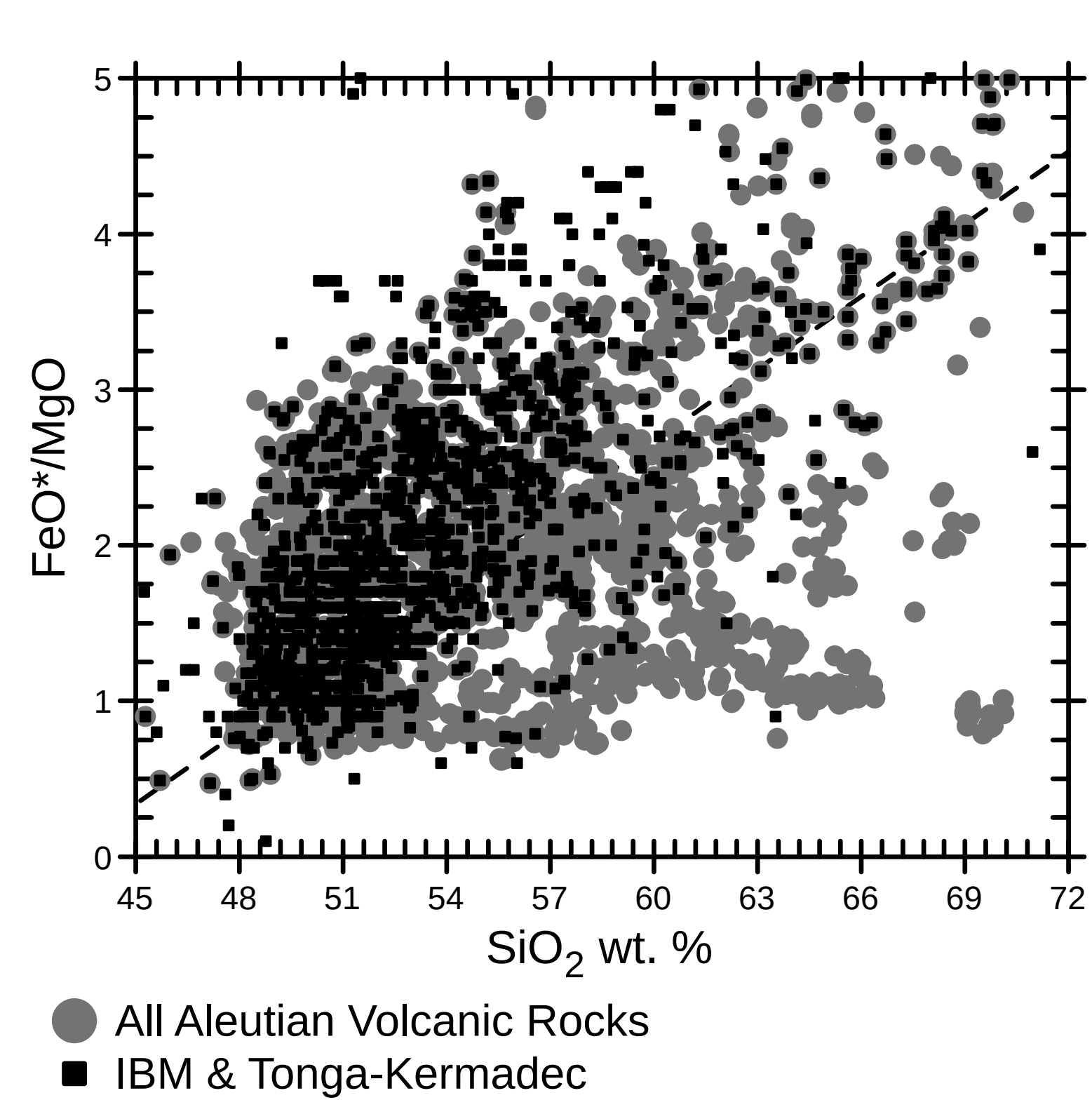
Aleutian Crust - Holbrook et al. (1999)

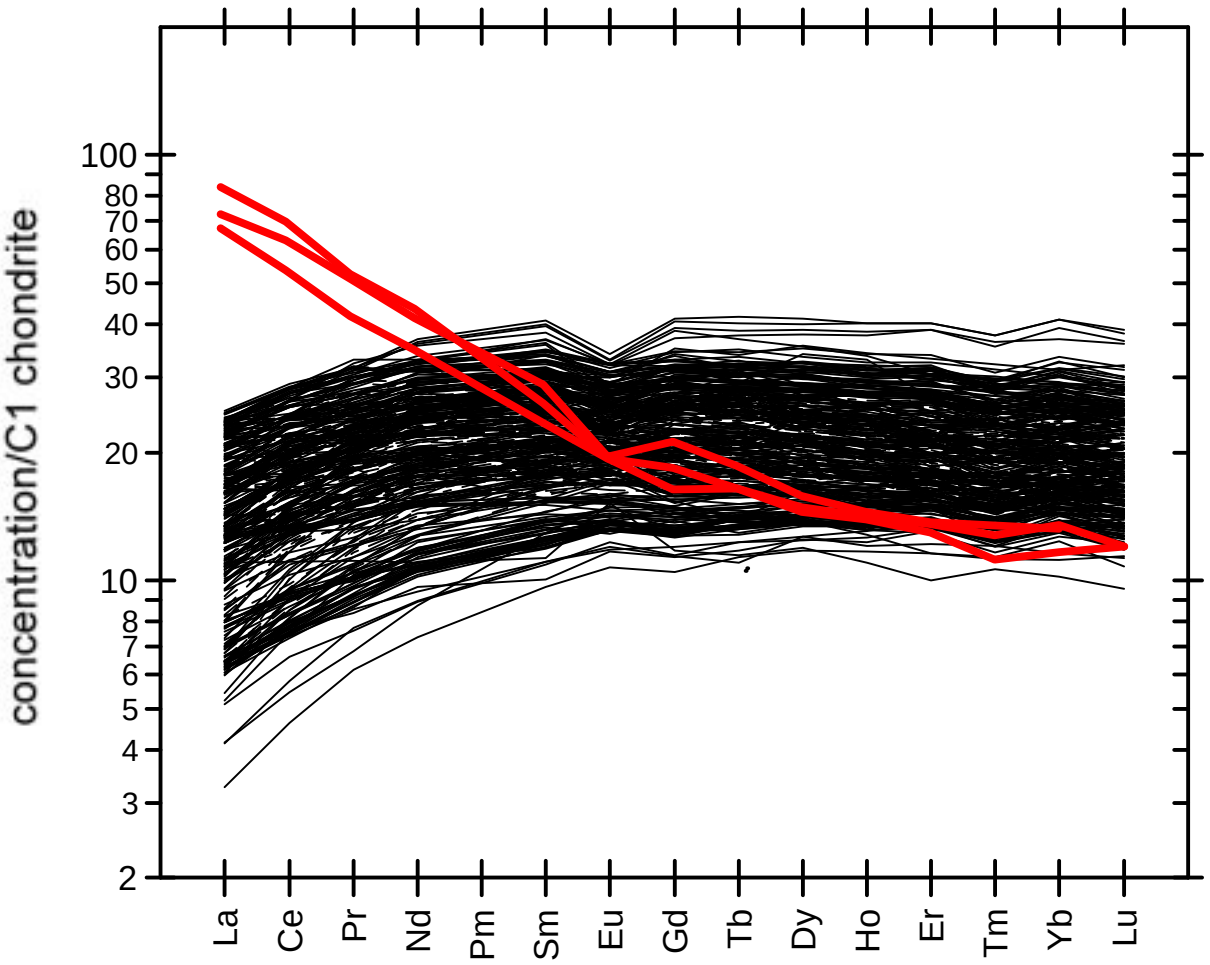
TABLE 1. ESTIMATES OF BULK CRUSTAL COMPOSITION

	Aleutian island arc*	Average continental crust†
SiO_2	49.5 ± 0.8	59.1
TiO_2	0.6 ± 0.2	0.7
Al_2O_3	16.2 ± 0.7	15.8
FeO	8.1 ± 0.4	6.6
MnO	0.2 ± 0.1	0.1
MgO	10.6 ± 1.3	4.4
CaO	13.0 ± 0.8	6.4
Na_2O	13.0 ± 0.8	3.2
K_2O	0.5 ± 0.2	1.9


IBM
0
1,000 km


Tonga - Kermadec
0
500 km

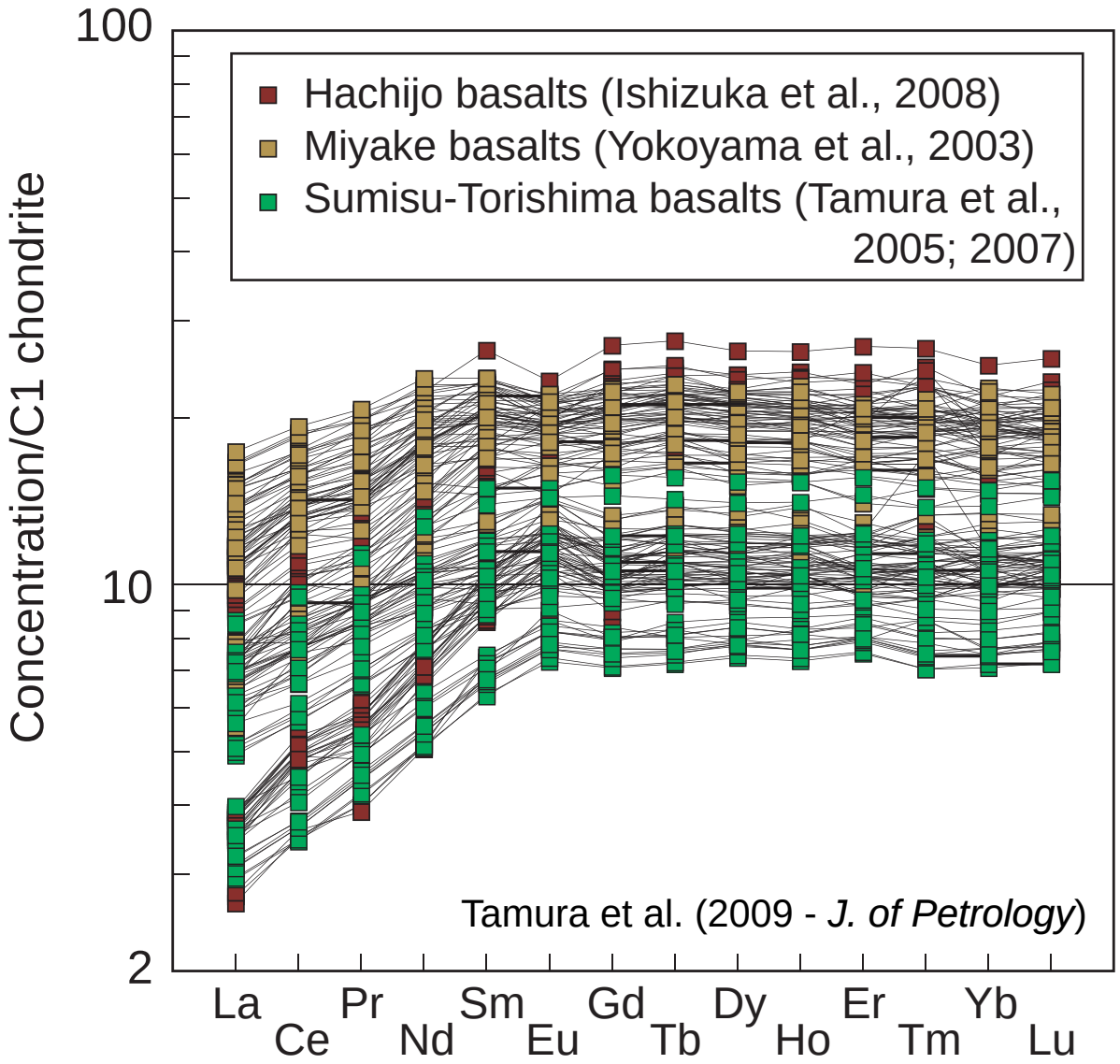

FeO*/MgO
0
1
2
3
4
5
45
48
51
54
57
60
63
66
69
72
SiO2 wt. %
All Aleutian Volcanic Rocks
IBM & Tonga-Kermadec

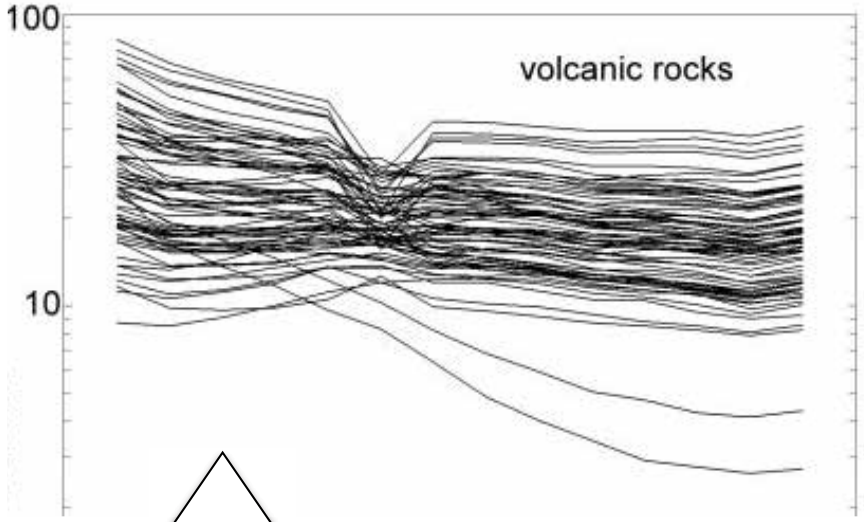


Continental Crust Estimates
Rudnick & Gao (3003)
Taylor & McLennan (1985)

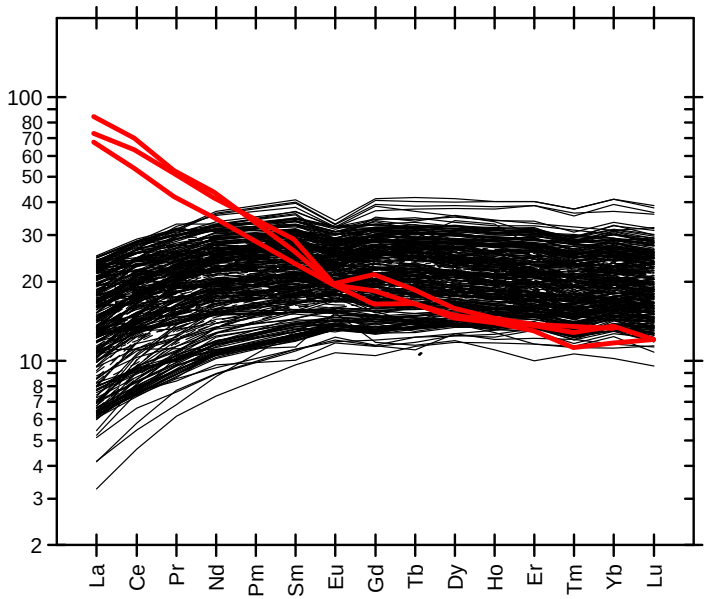
Marine Sediment
Plank (2014) - DSDP183

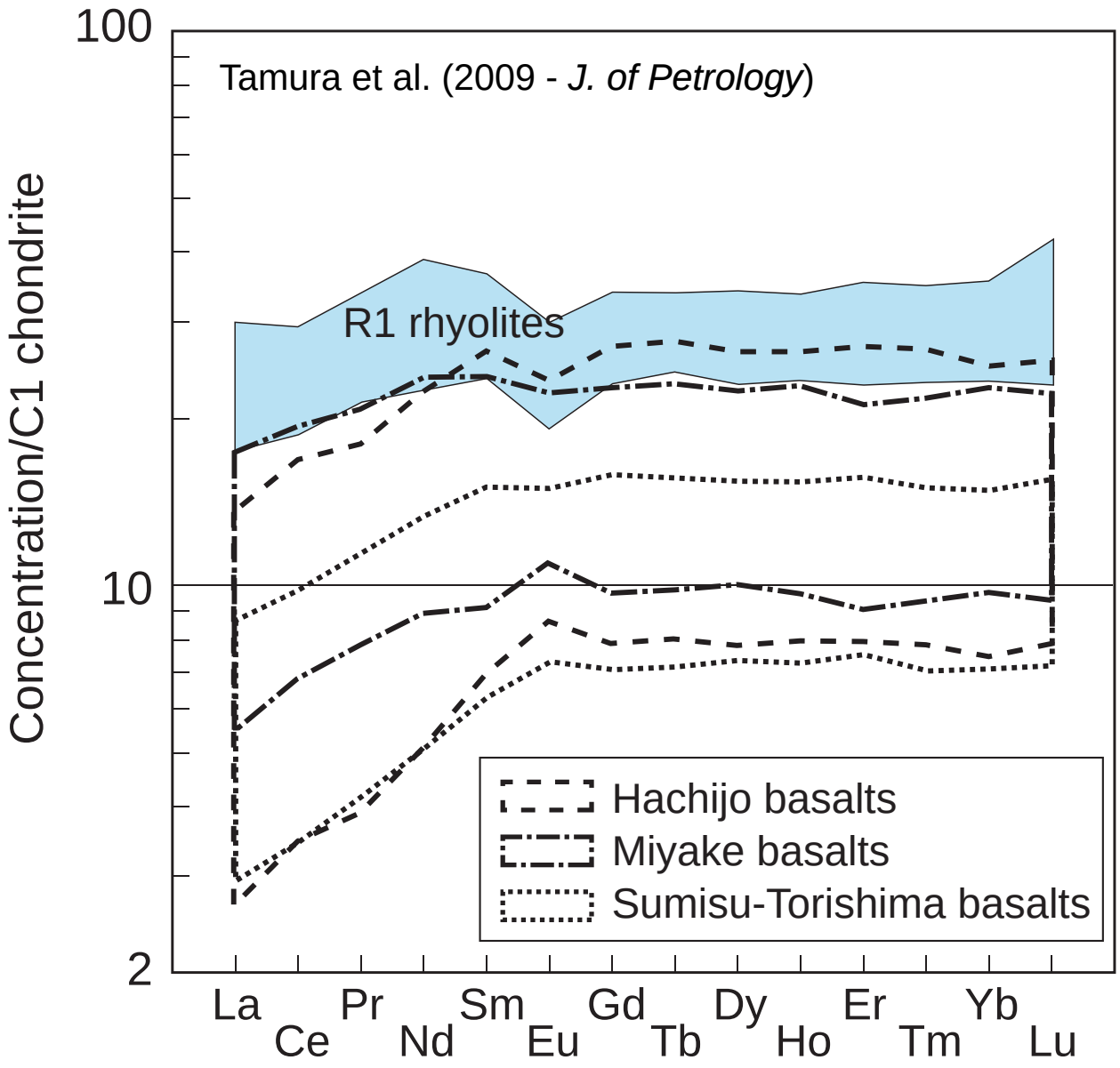
Oceanic Crust
Pacific MORB

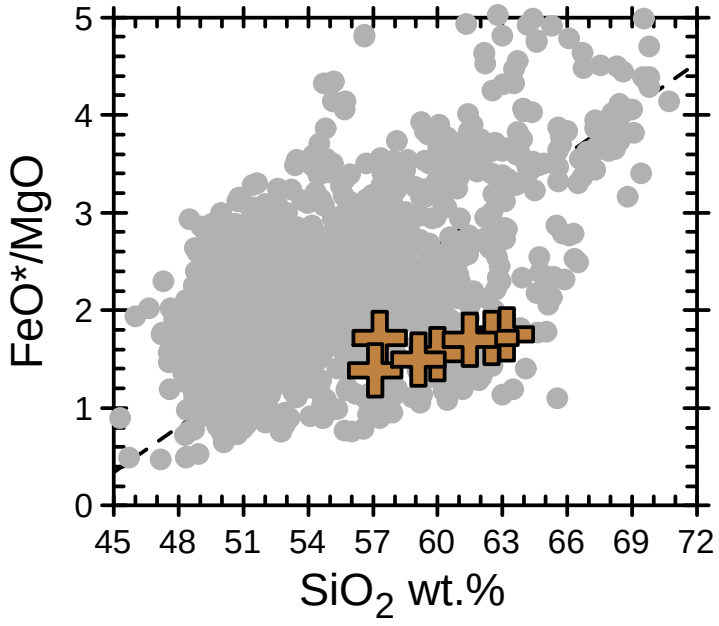


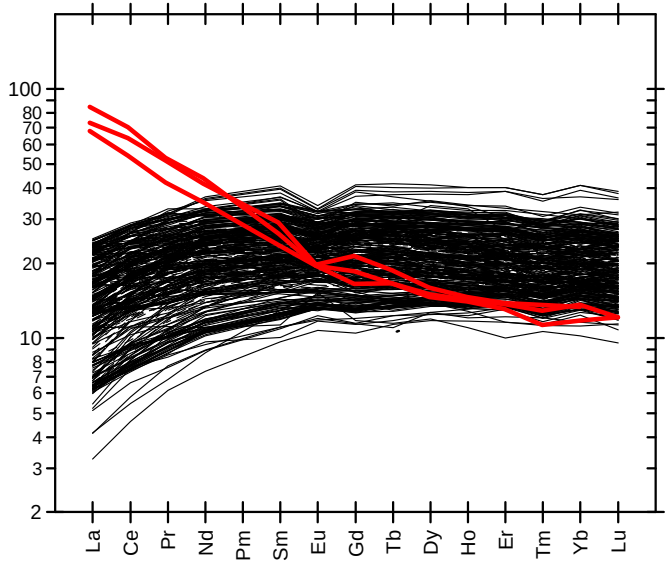


Talkeetna? Alisitos?




Tamura et al. (2009 - J. of Petrology)
R1 rhyolites
Hachijo basalts
Miyake basalts
Sumisu-Torishima basalts
Concentration/C1 chondrite
100
10
2
La
Ce
Pr
Nd
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu


FeO*/MgO
SiO2 wt.%
0
1
2
3
4
5
45
48
51
54
57
60
63
66
69
72


100
80
70
60
50
40
30
20
10
8
7
6
5
4
3
2
La
Ce
Pr
Nd
Pm
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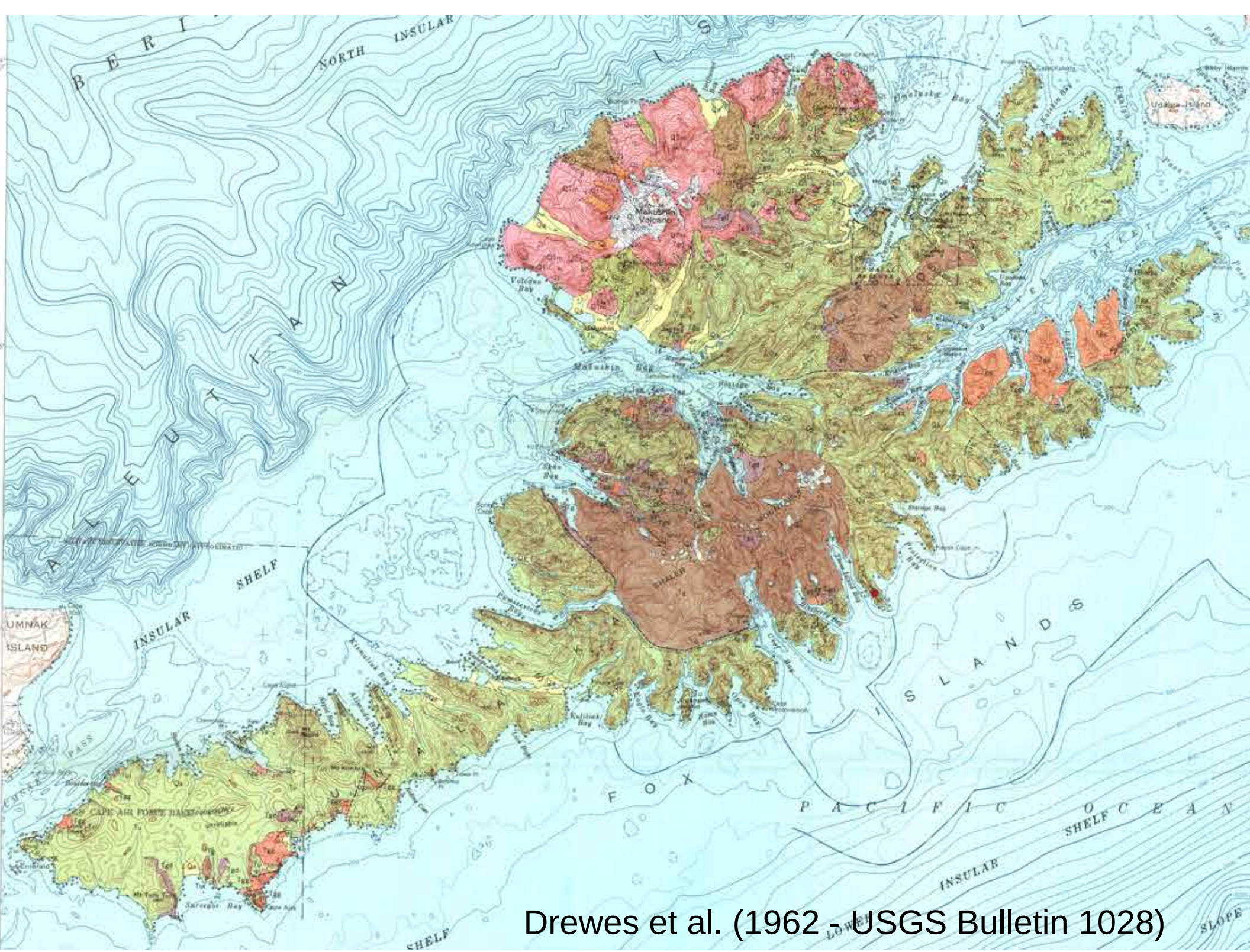
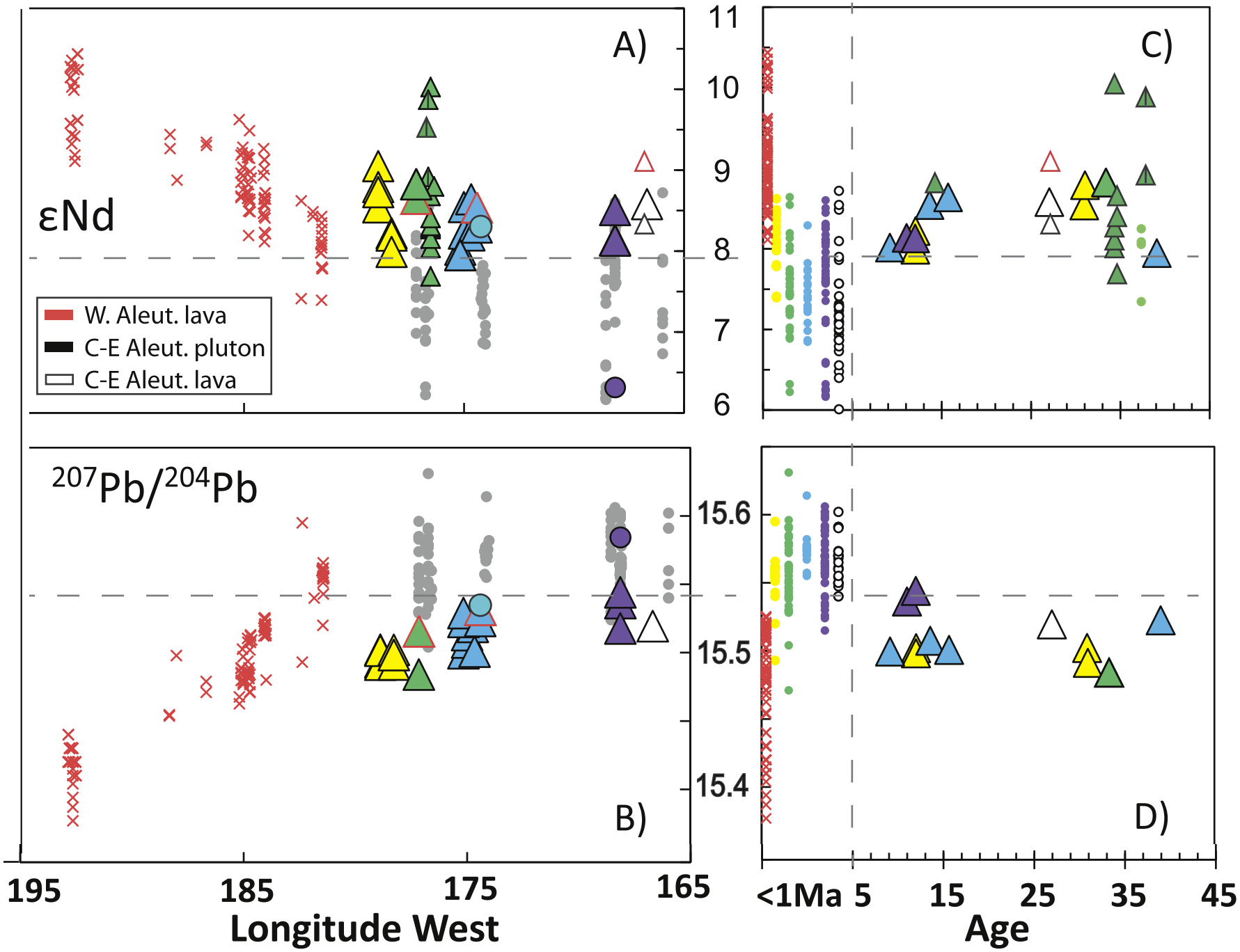
Ho
Er
Tm
Yb
Lu



Drewes et al. (1962 - USGS Bulletin 1028)



Cai et al. (1915 - *EPSL*)