Geochemistry and Petrogenesis of the Ossipee Ring Complex: A Model for Magmatism in the Younger White Mountain Igneous Province

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Monteregian Hills - White Mountain Igneous Provinces

Plutons

6

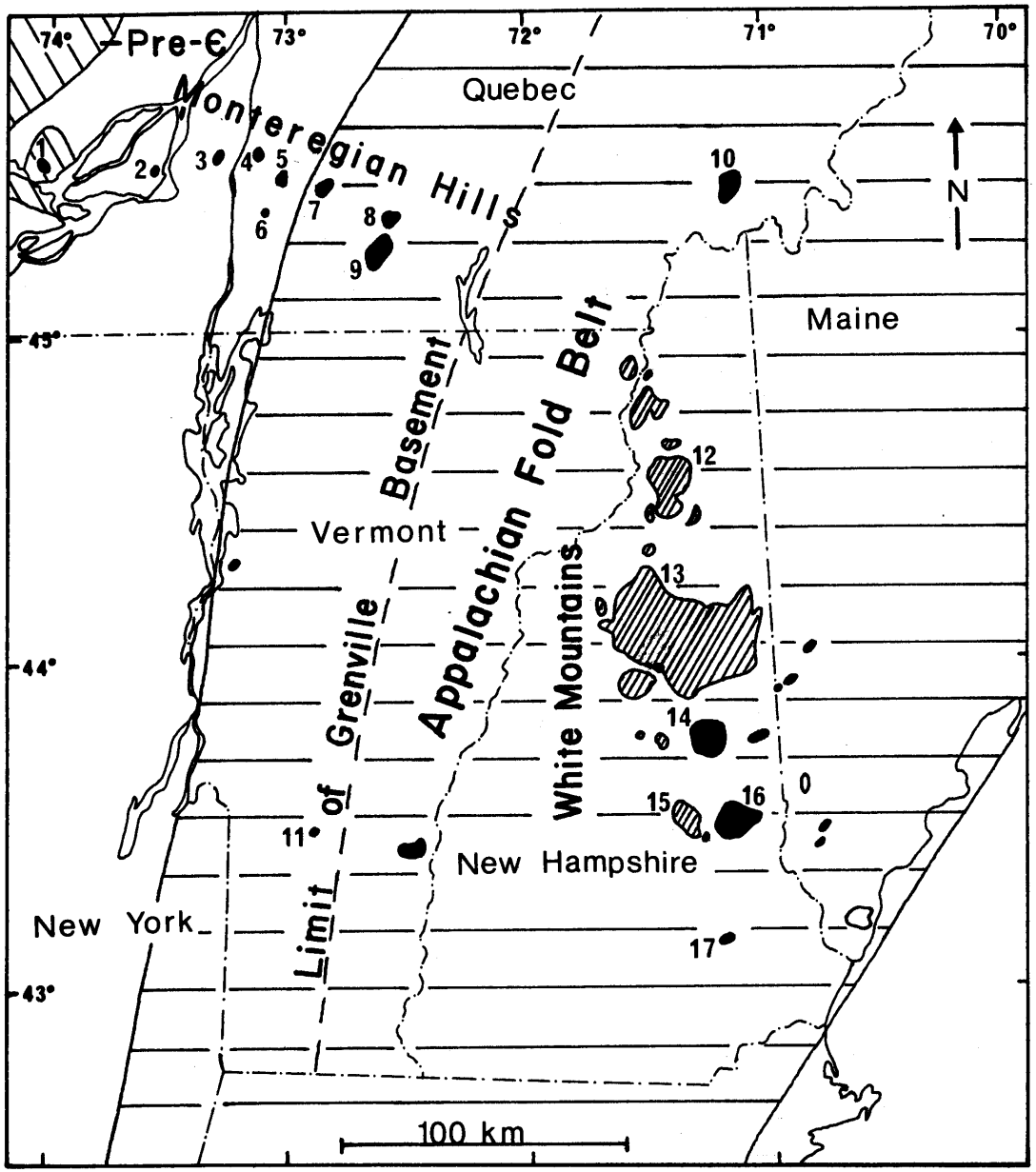
Mount Johnson

11

Cuttingsville

14

Ossipee

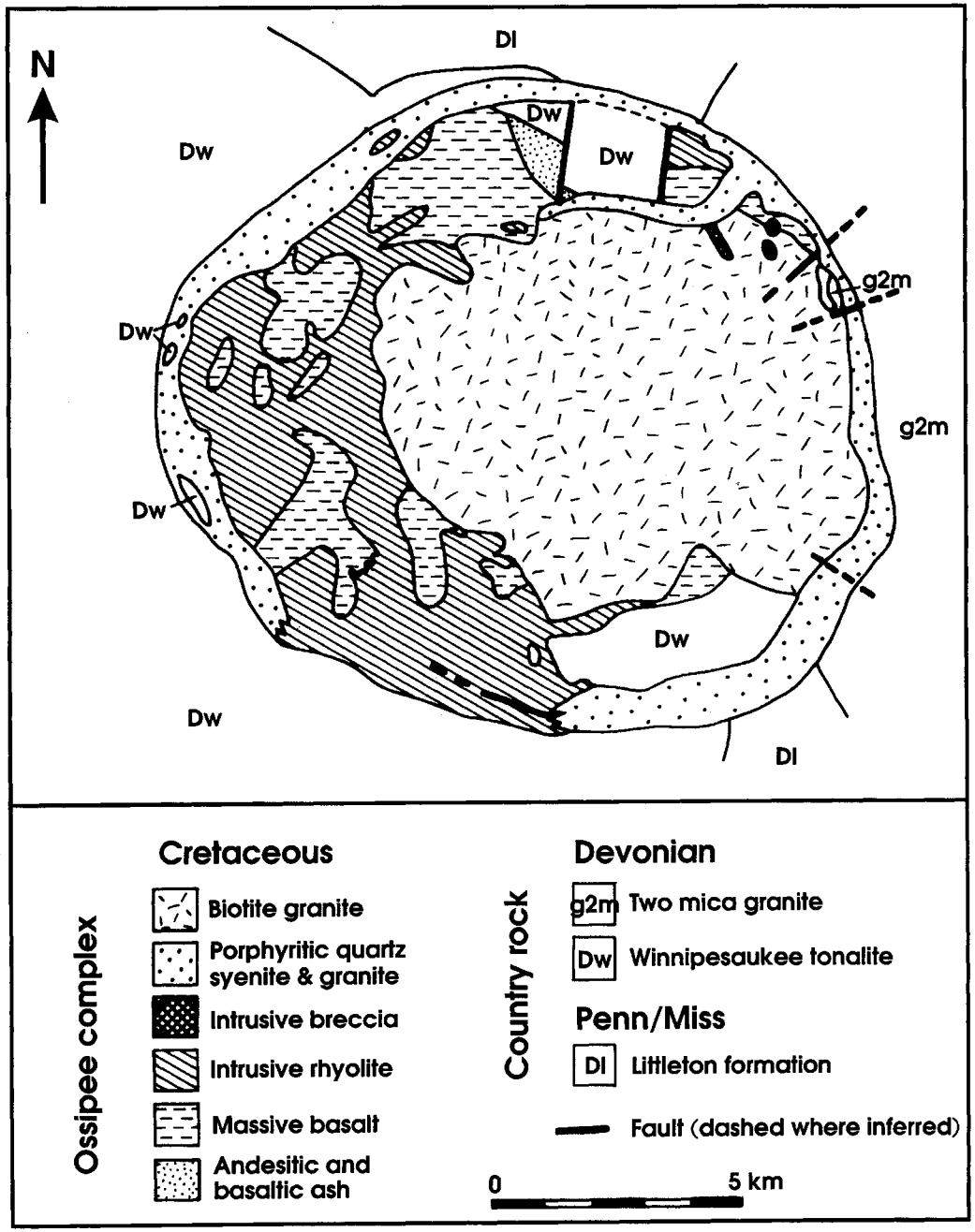


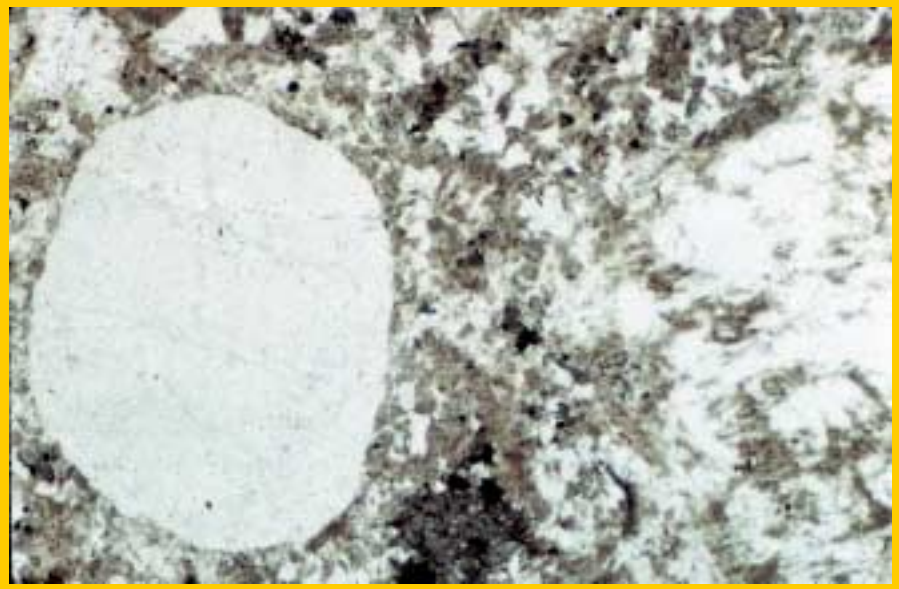
Cross-hatched plutons

150 - 220 Ma

Filled plutons

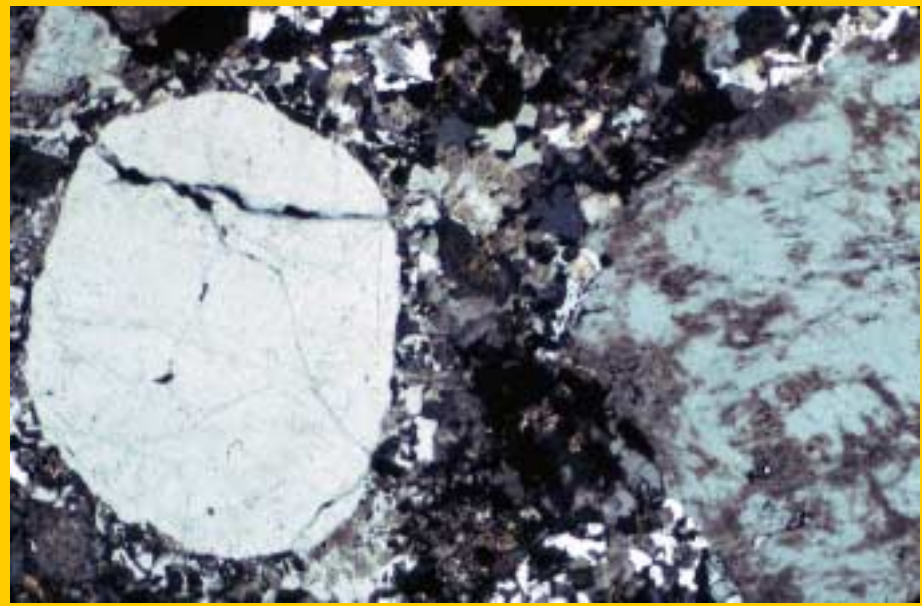
100 - 125 Ma

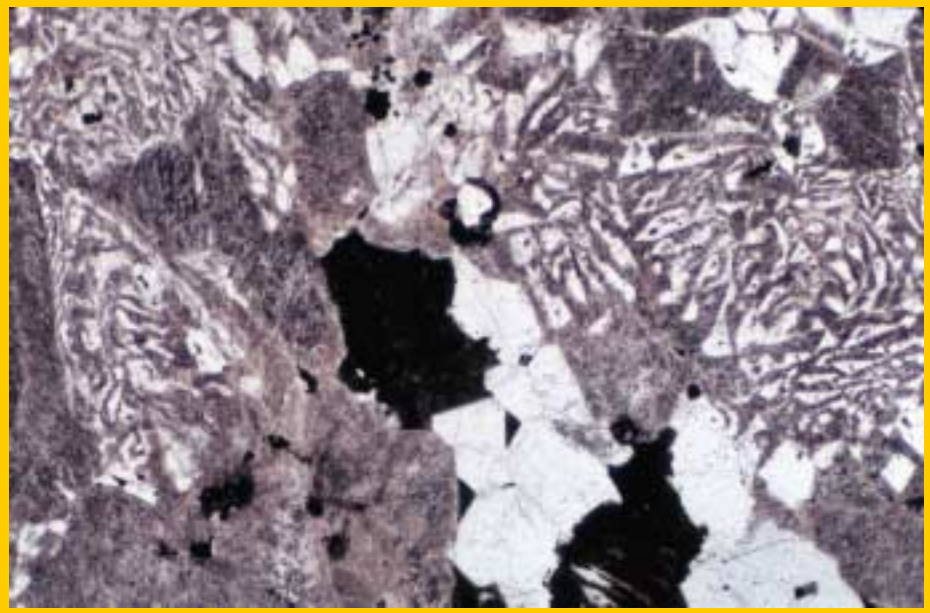

N
Dl
Dw
Dw
Dw
g2m
Dw
g2m
Dw
Dw
Dw
Dl
Ossipee complex
Cretaceous
Biotite granite
Porphyritic quartz syenite & granite
Intrusive breccia
Intrusive rhyolite
Massive basalt
Andesitic and basaltic ash
Country rock
Devonian
g2m Two mica granite
Dw Winnipesaukee tonalite
Penn/Miss
Dl Littleton formation
Fault (dashed where inferred)
0
5 km



OS3 - Porphyritic quartz syenite. Plane light. 25X. From the ring dike.

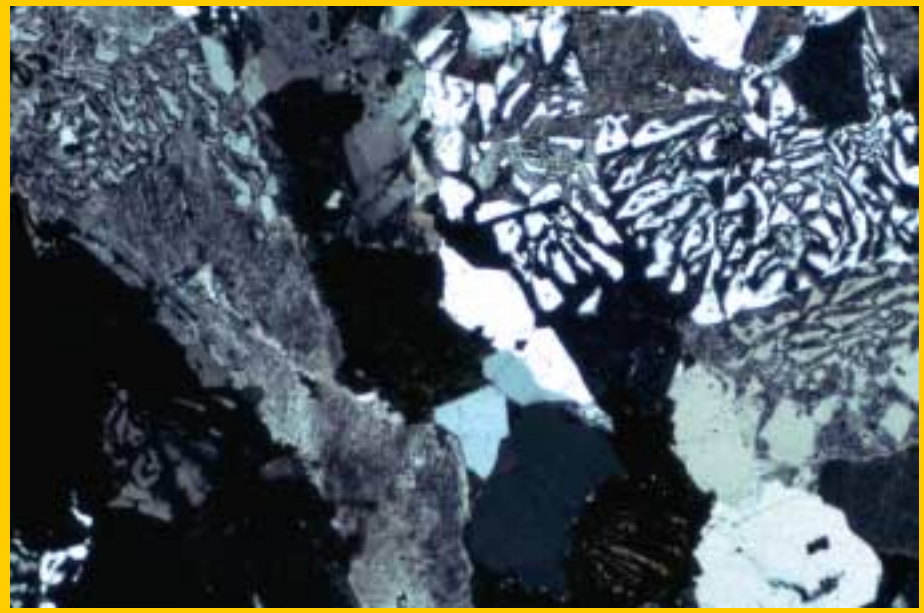
OS3 - Porphyritic quartz syenite. Crossed-nicols. 25X





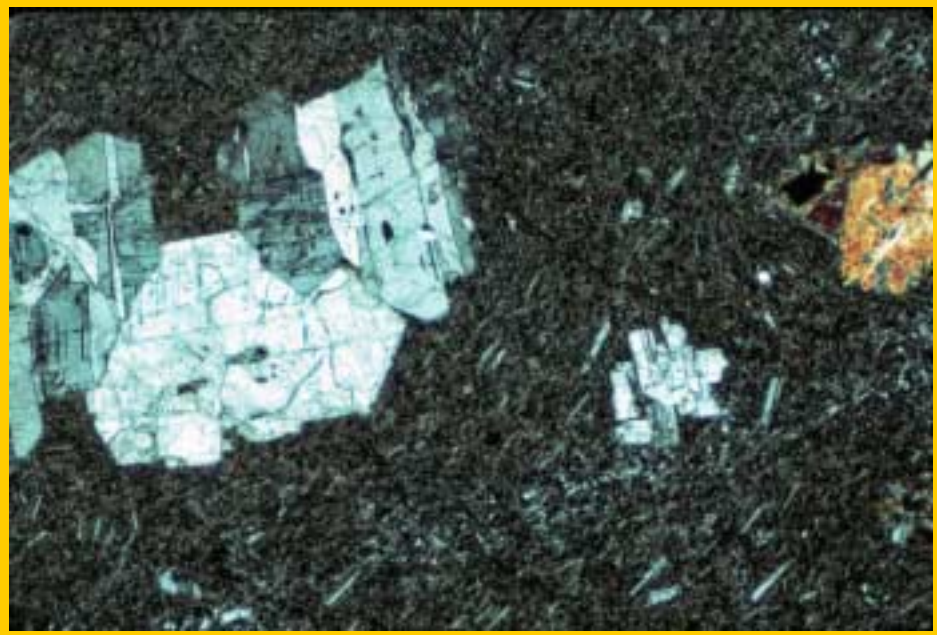
OS20 - Medium-grained granite. Plane light. 25X. Note graphic texture. From the ring dike.

OS20 - Medium-grained granite. Crossed-nicols. 25X



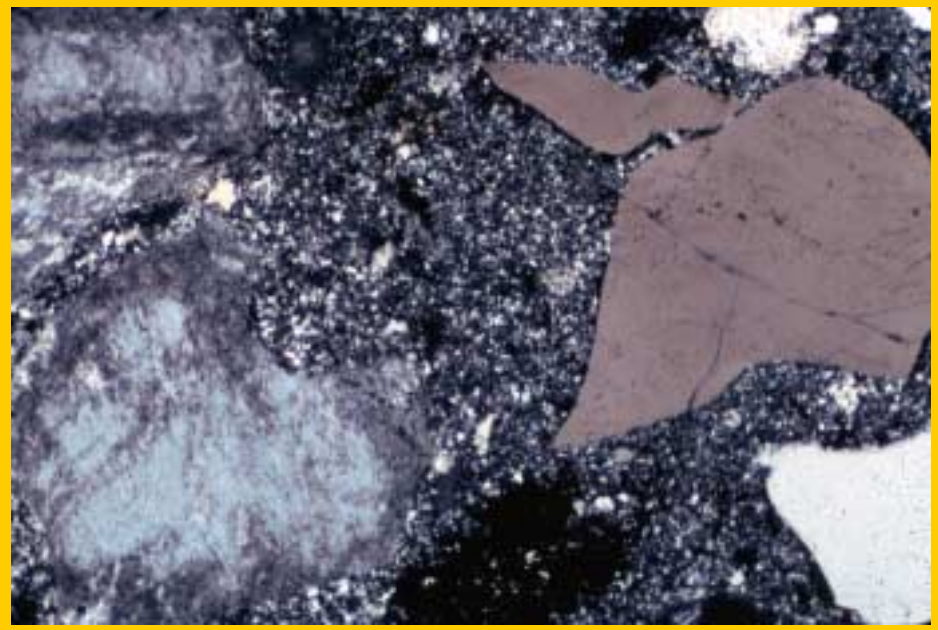
OS14 - Basalt. Plagioclase and pyroxene phenocrysts. Plane light. 25X

OS14 - Basalt. Crossed-nicols. 25X



OS17 - Rhyolite. Quartz and K-feldspar phenocrysts. Plane light. 25X

OS17 - Rhyolite. Crossed-nicols. 25X

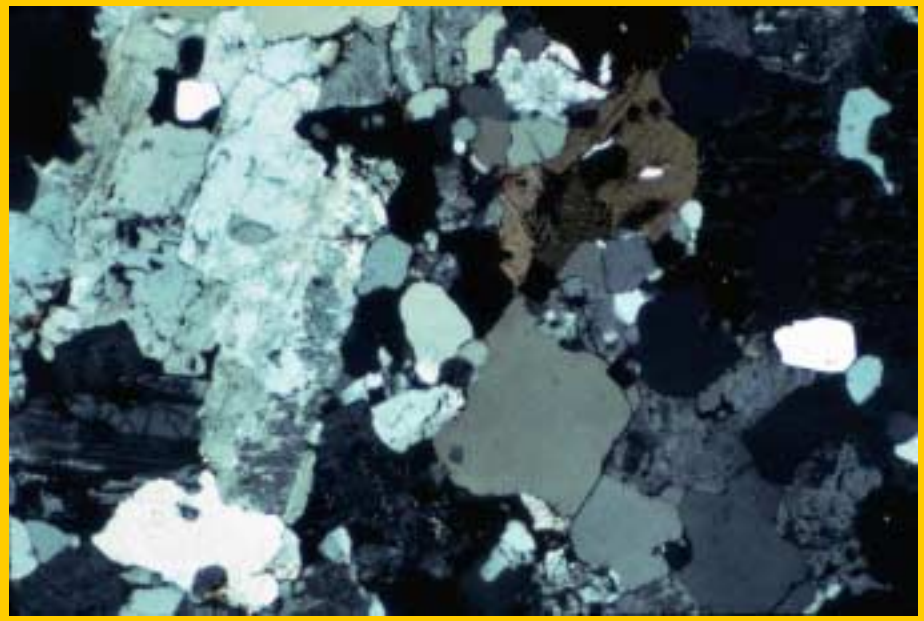


OS44 - Coarse-grained

Conway granite. Plane light. 25X

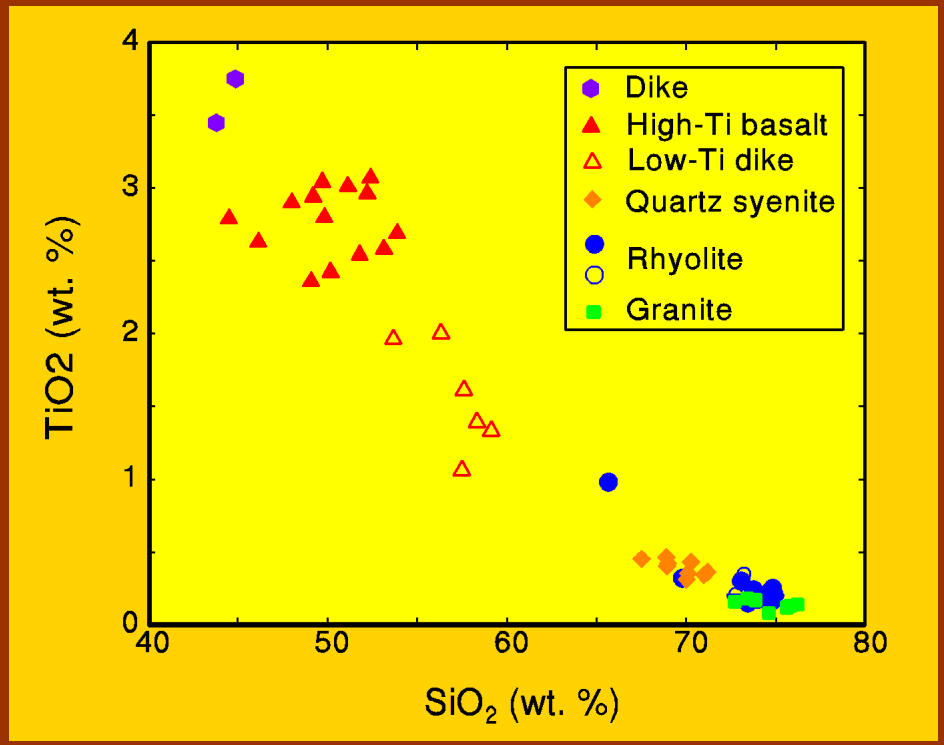
OS44 - Coarse-grained

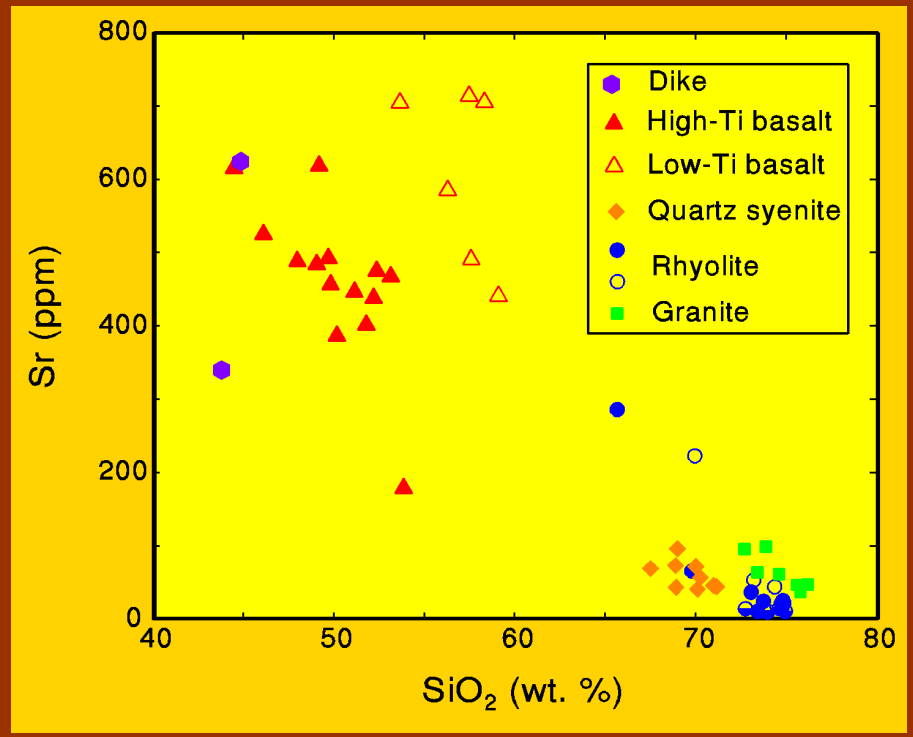
Conway granite. Crossed-nicols. 25X



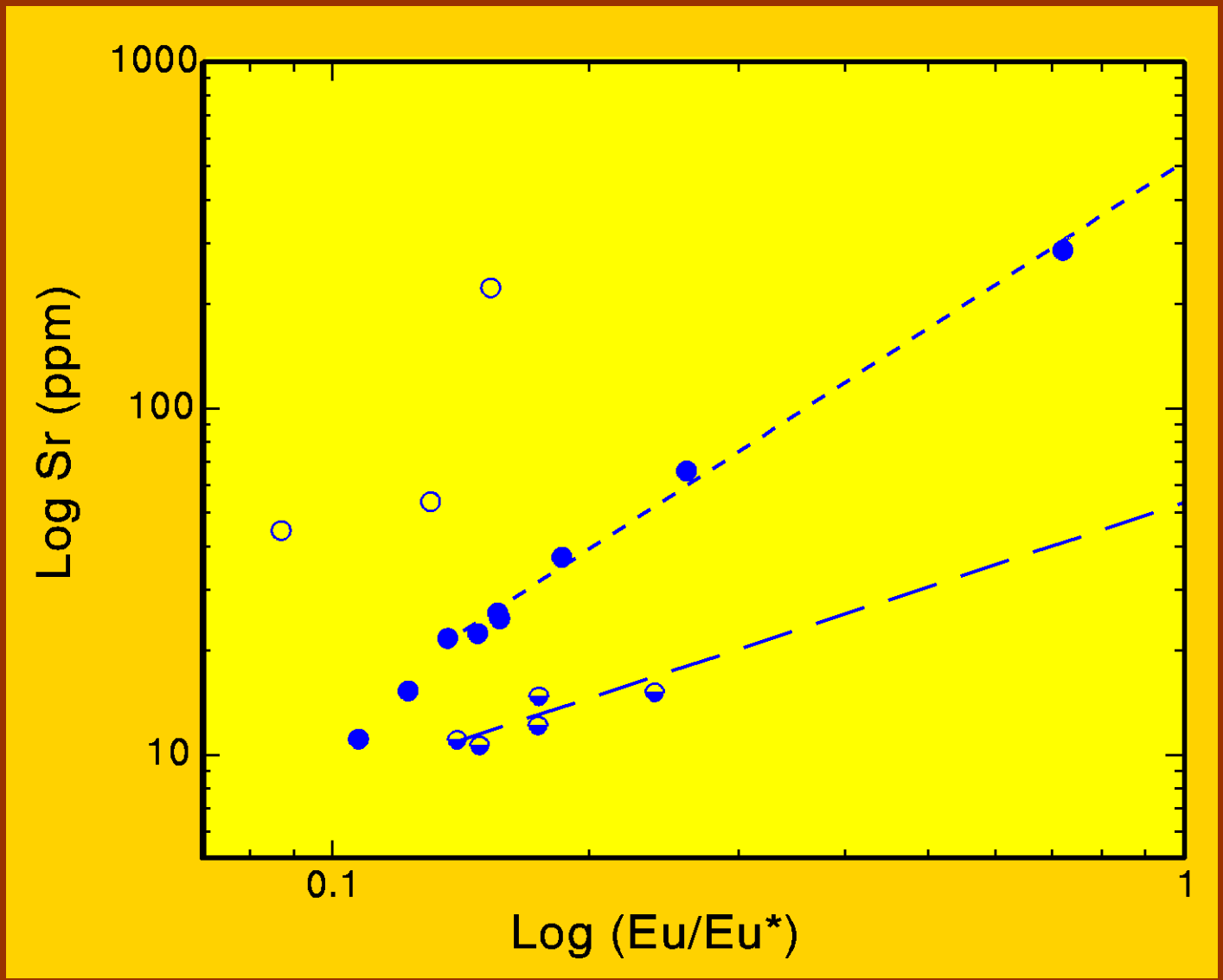
Harker diagrams showing the chemistry of the major rock types

Low- and high-Ti basalts differ in Ti and Sr content

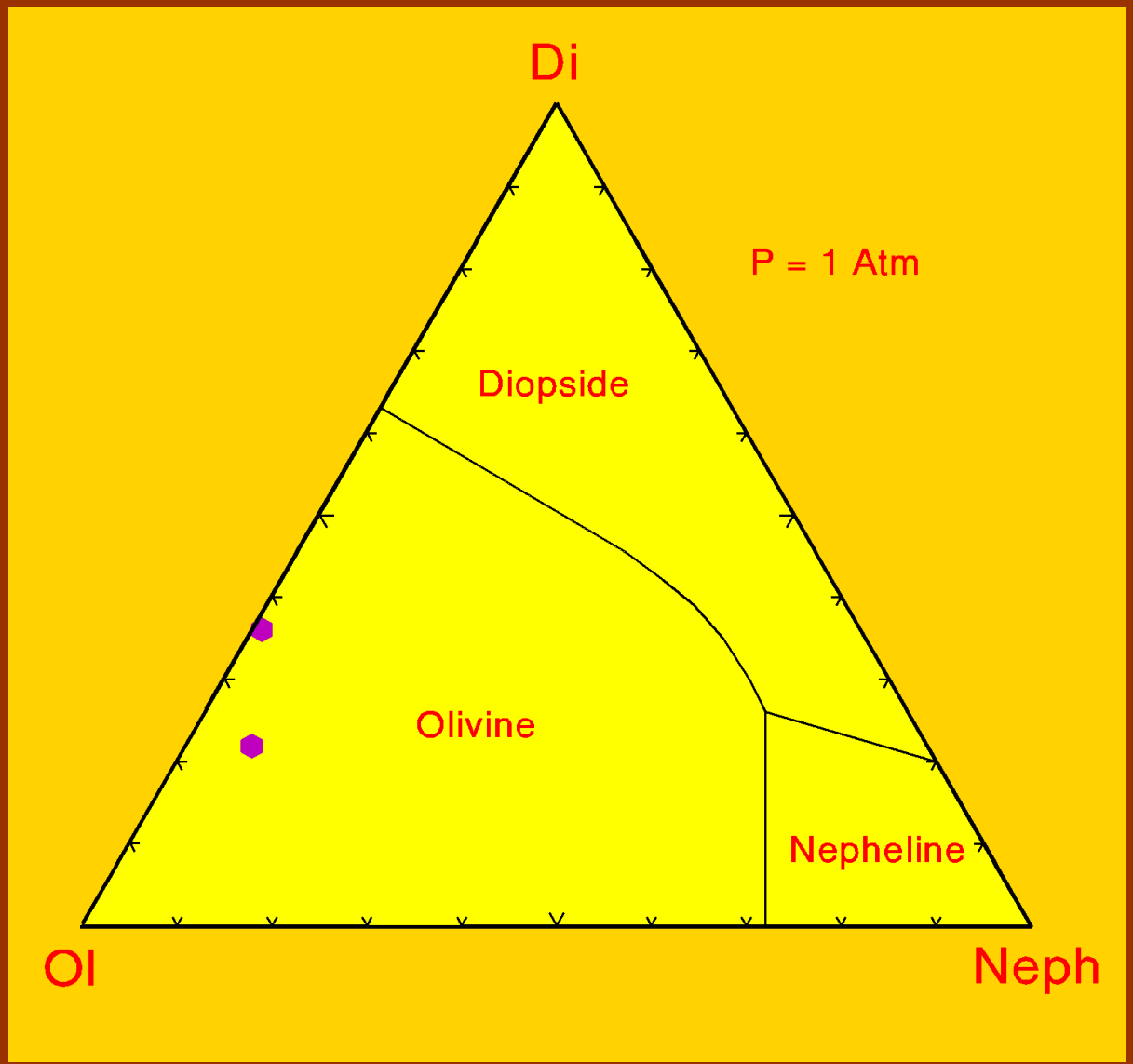




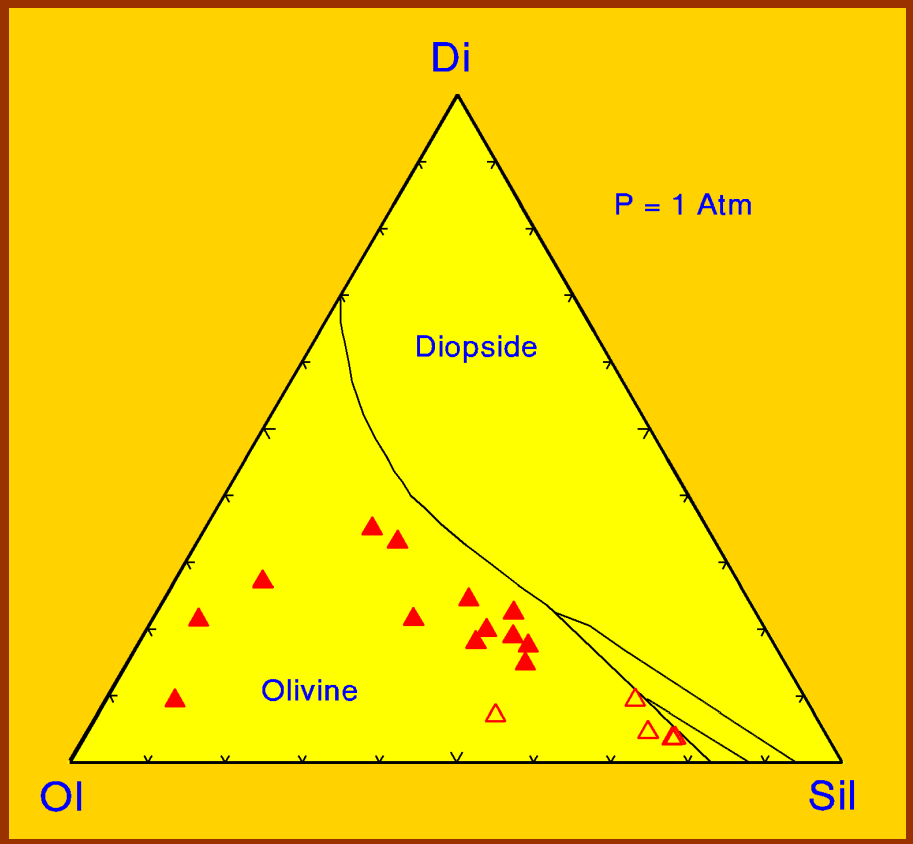
Two rhyolite sequences can be identified on the basis of Eu and Sr geochemistry - a low- and high-Sr sequence

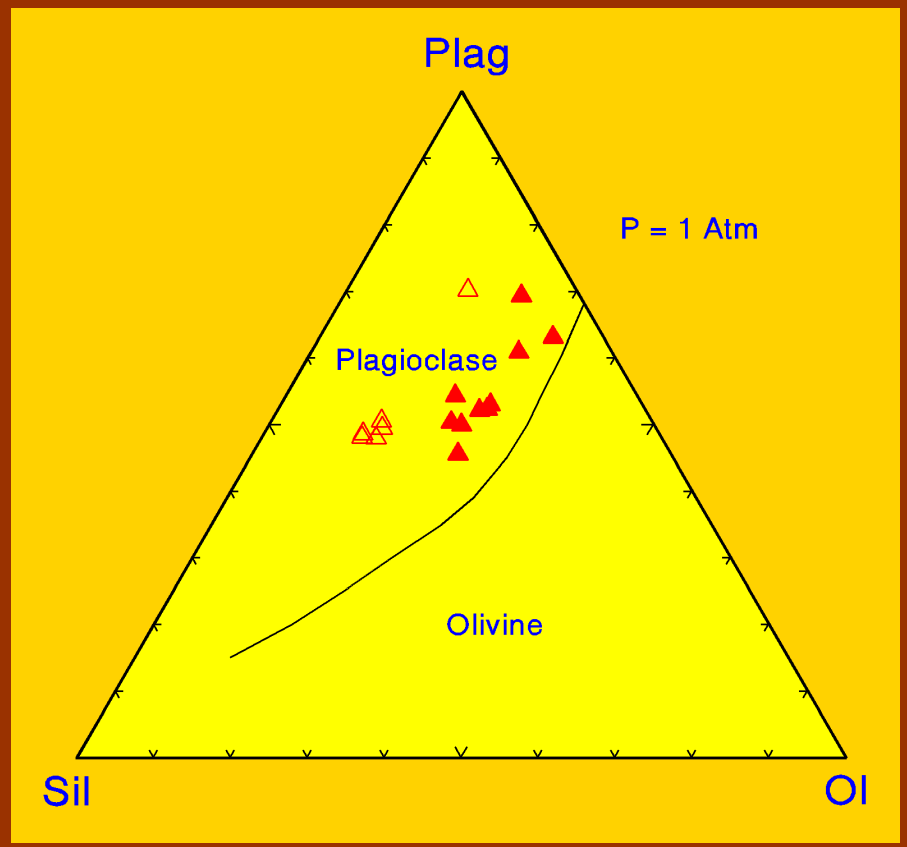


Phase relations for nepheline-normative basalts

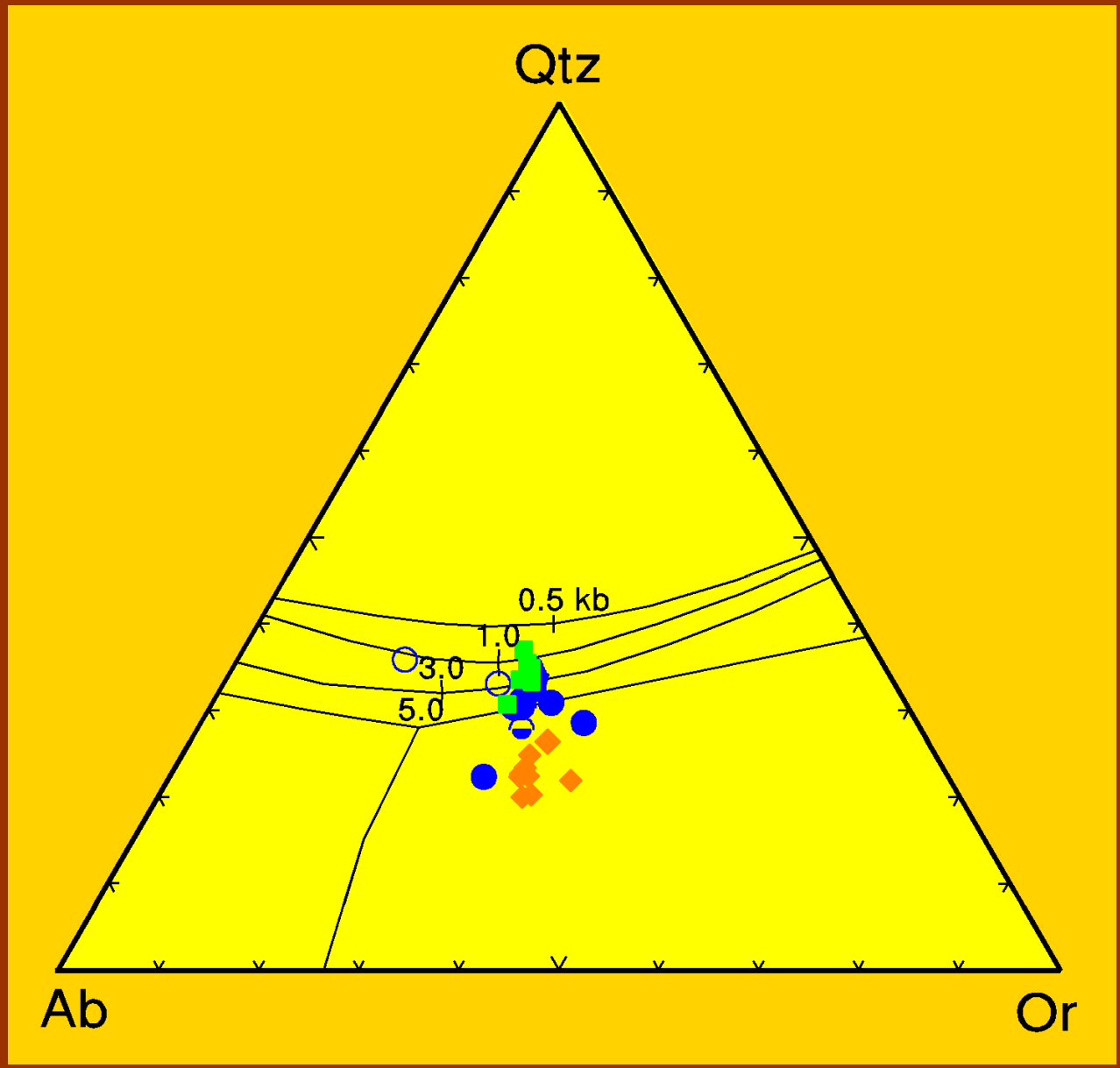


Compositions of high-Ti and low-Ti basalts projected into the Ol-Di-Sil and Sil-Plag-Ol ternary phase diagrams

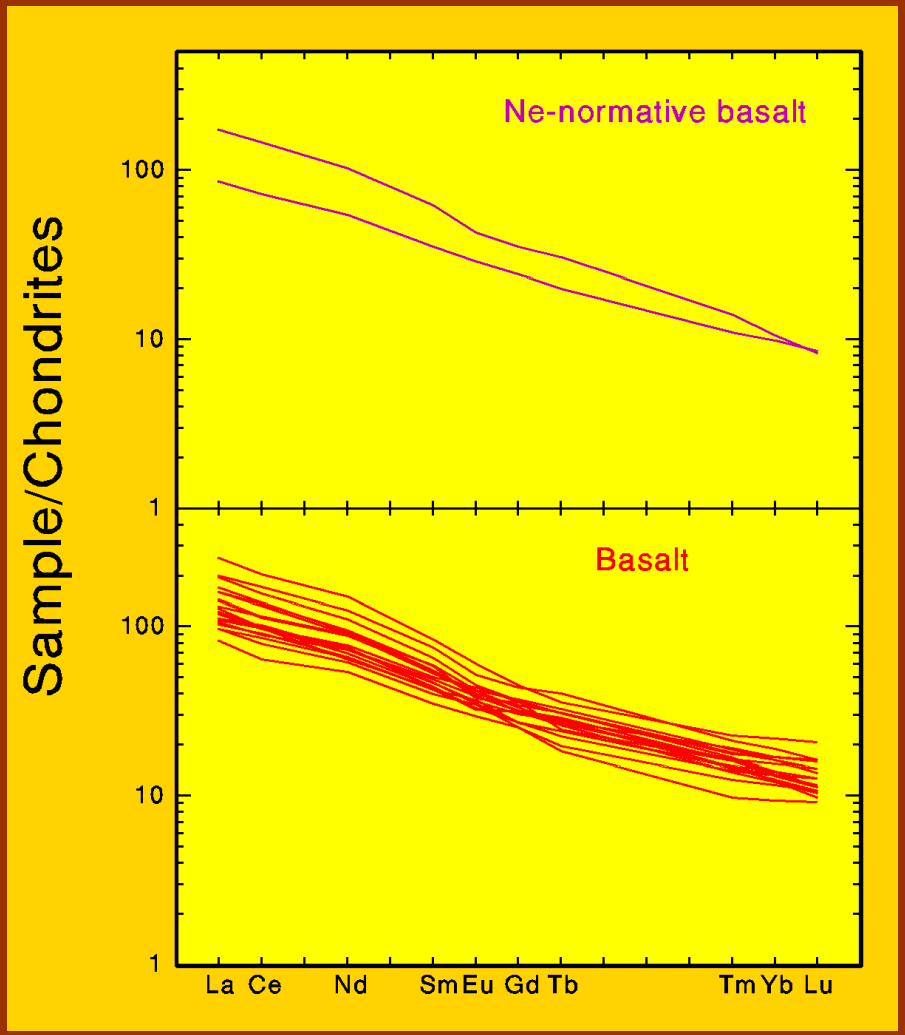


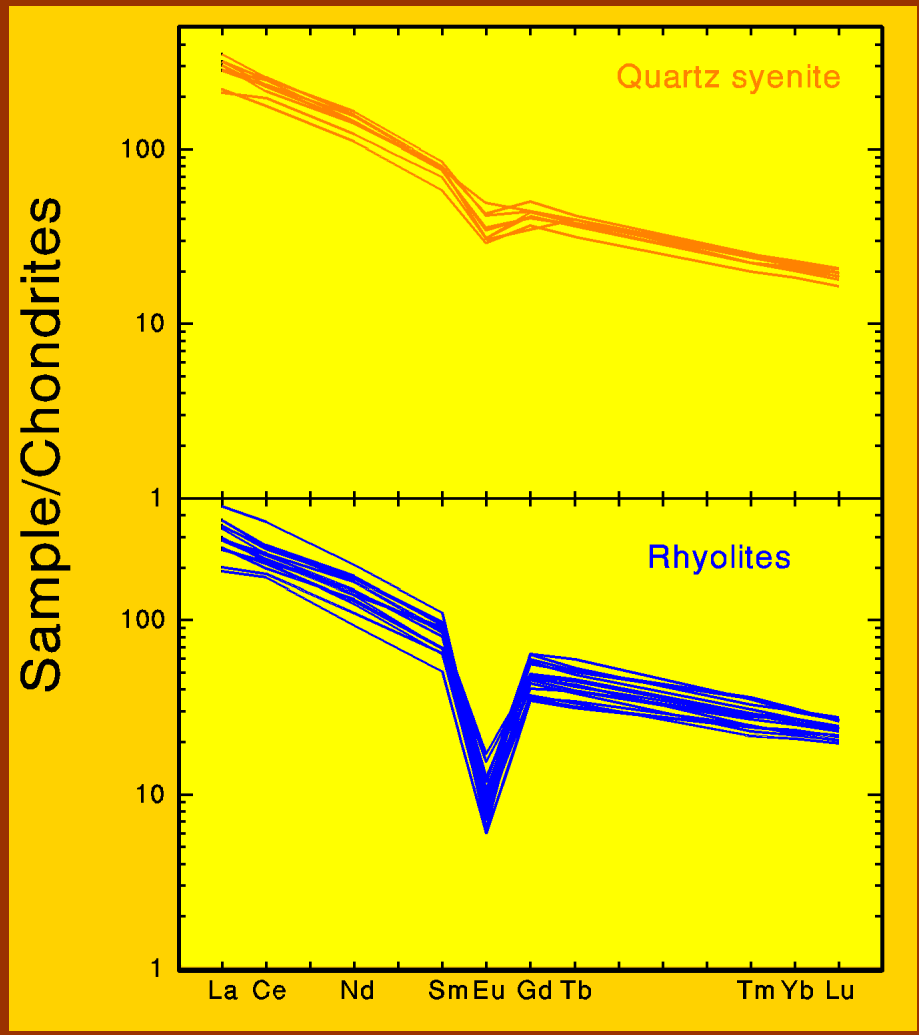


Quartz syenites, rhyolites, granites plotted in the system Ab-Qtz-Or

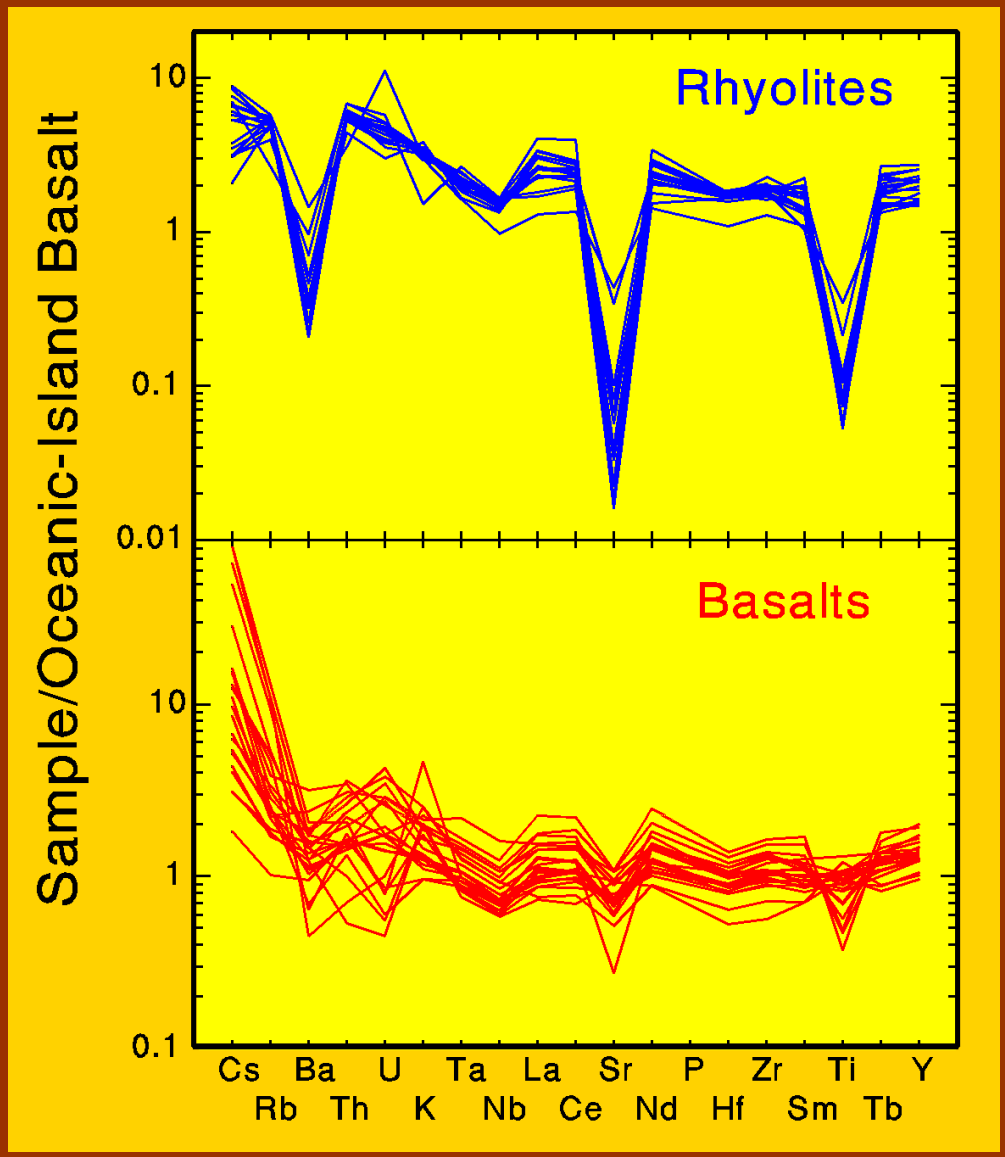


Chondrite normalized REE plots for basalts, quartz syenites and rhyolites

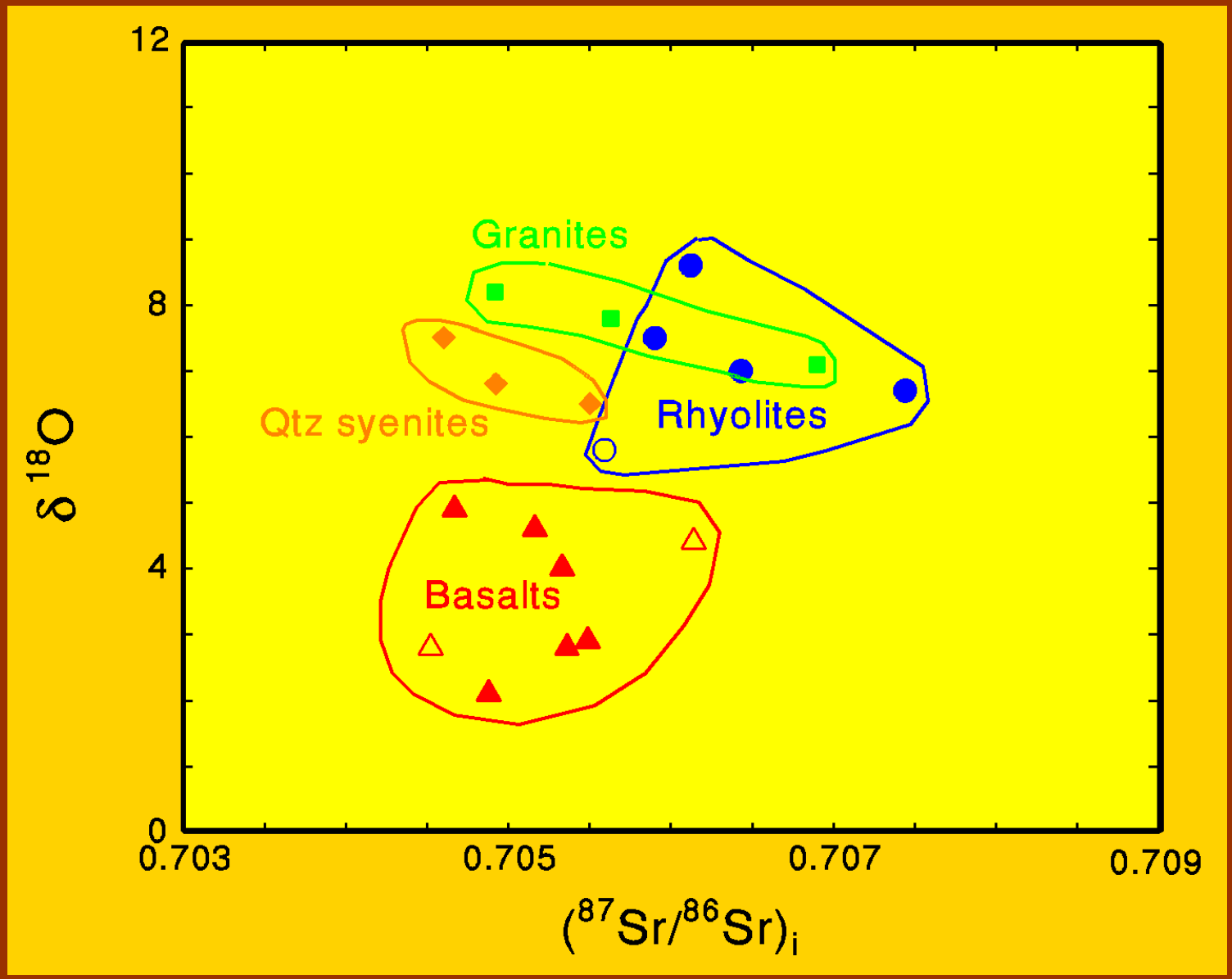




OIB-normalized spider diagrams for rhyolites and basalts



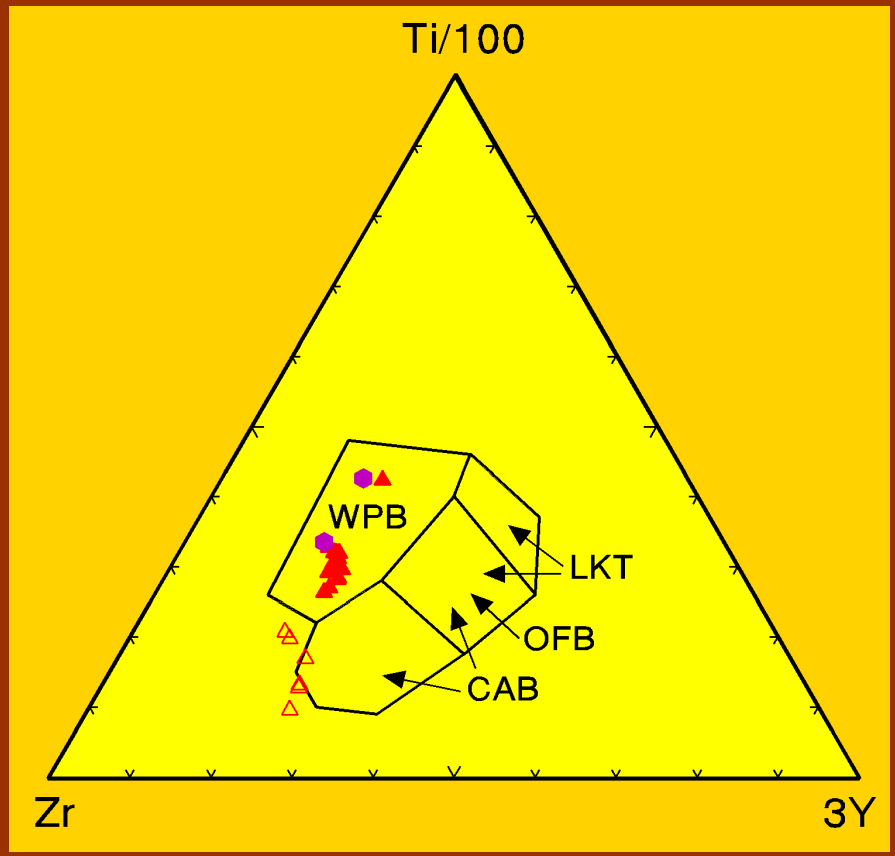
Initial Sr vs $\delta^{18}O$ for the major Ossipee lithologies

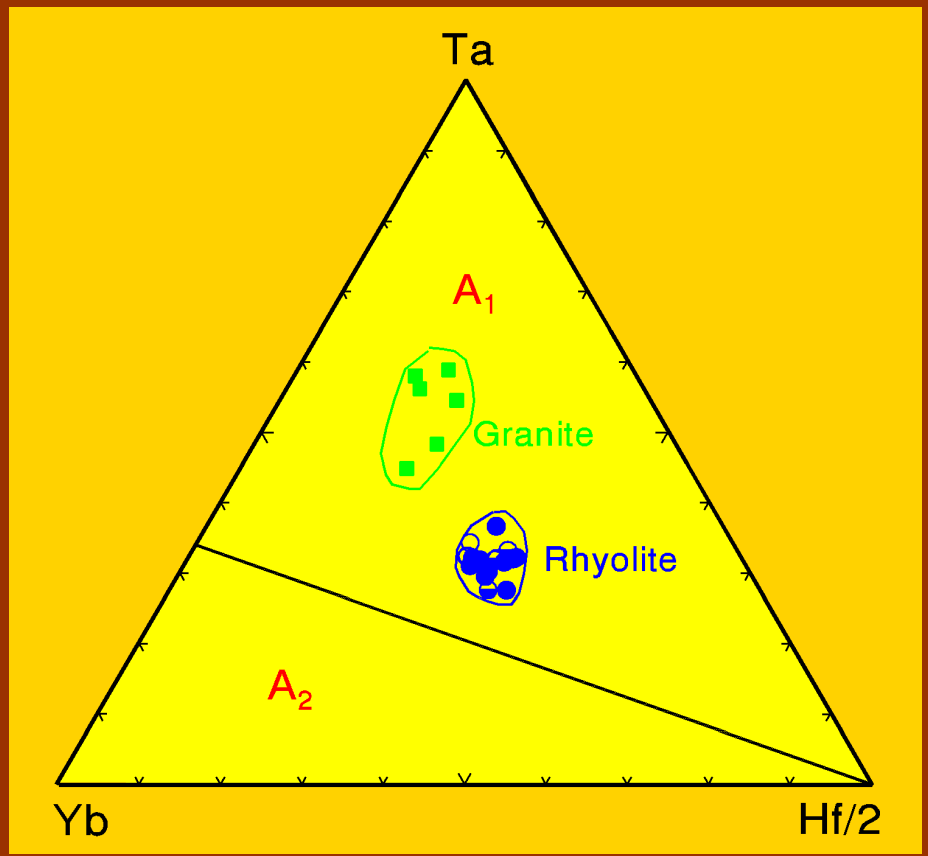


Basalt and A-type granitoid discriminant diagrams

Ossipee basalts plot in the Within Plate field

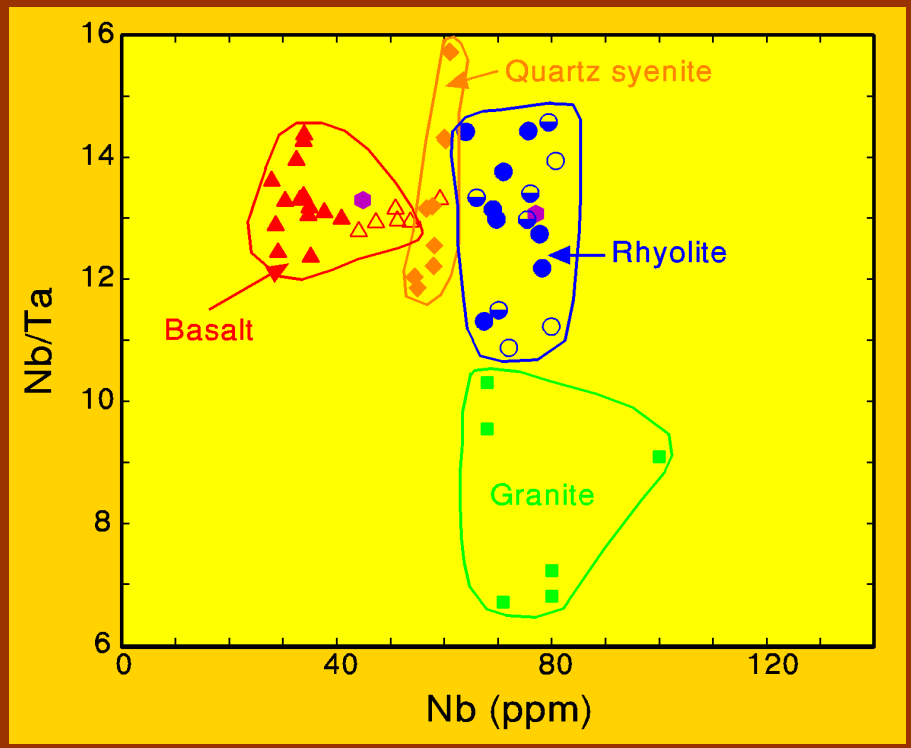
Ossipee granites and rhyolites plot in the OIB-like source field

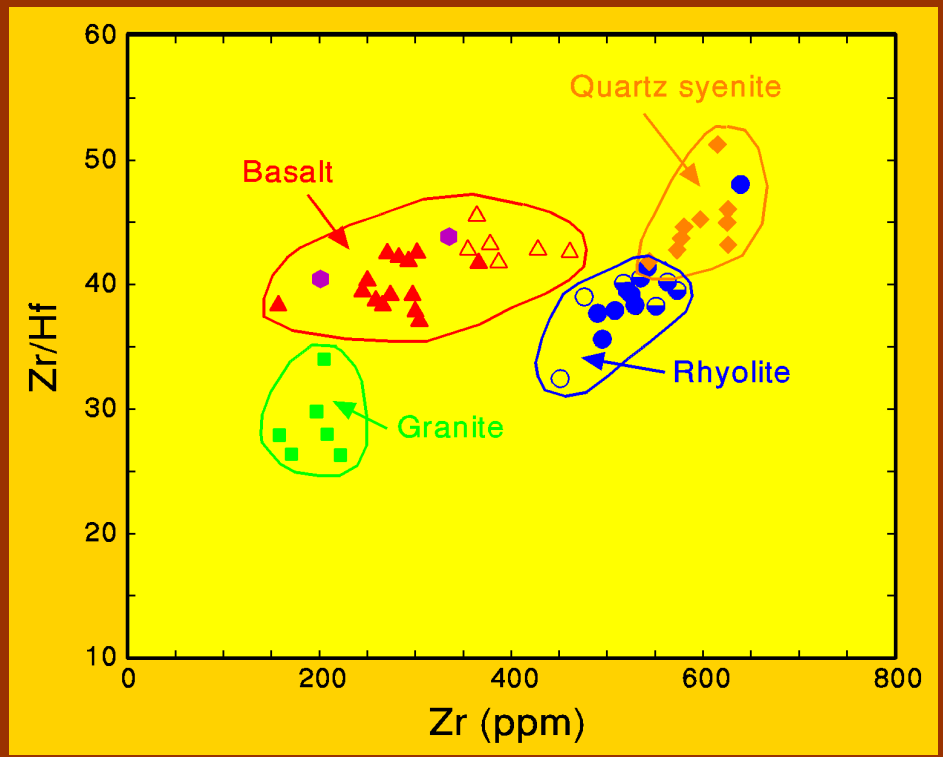




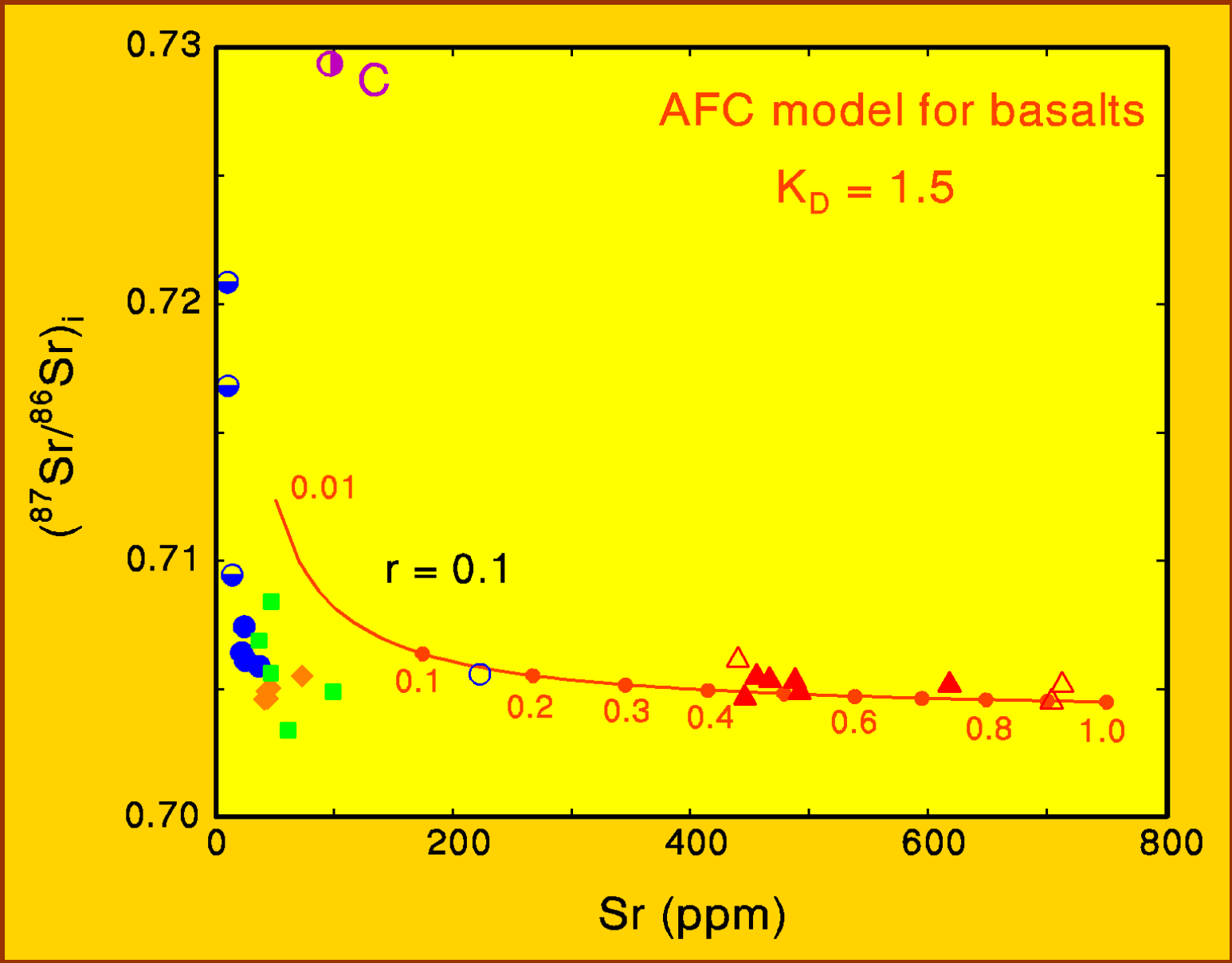
Nb/Ta and Zr/Hf ratios for the major Ossipee rock types.

Typical mantle ratios: Nb/Ta = 15-17 Zr/Hf = 40

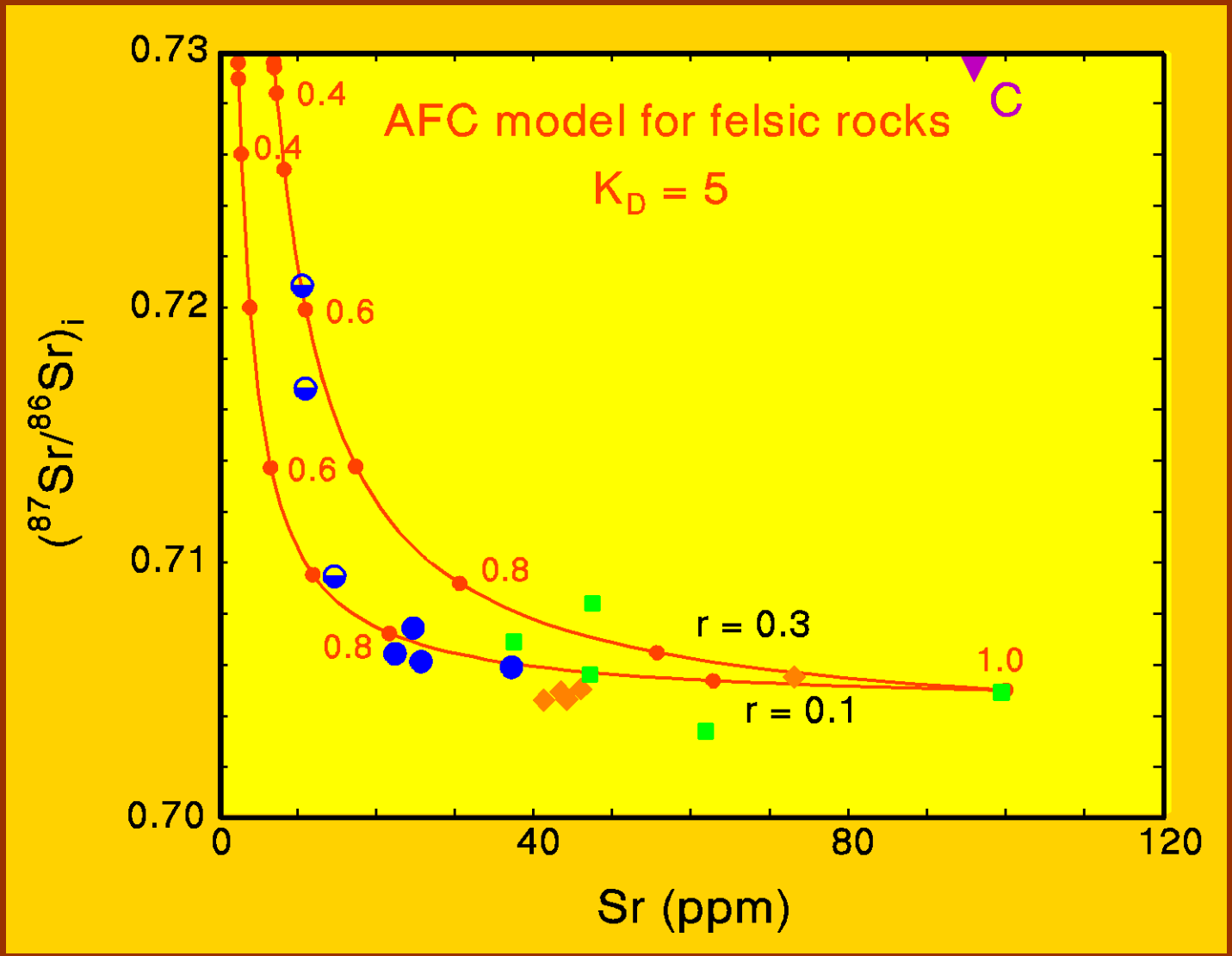




AFC model for basalts showing minimal role of crustal contamination



AFC model for felsic rocks. Except for the most evolved rocks, crustal contamination is relatively minor.



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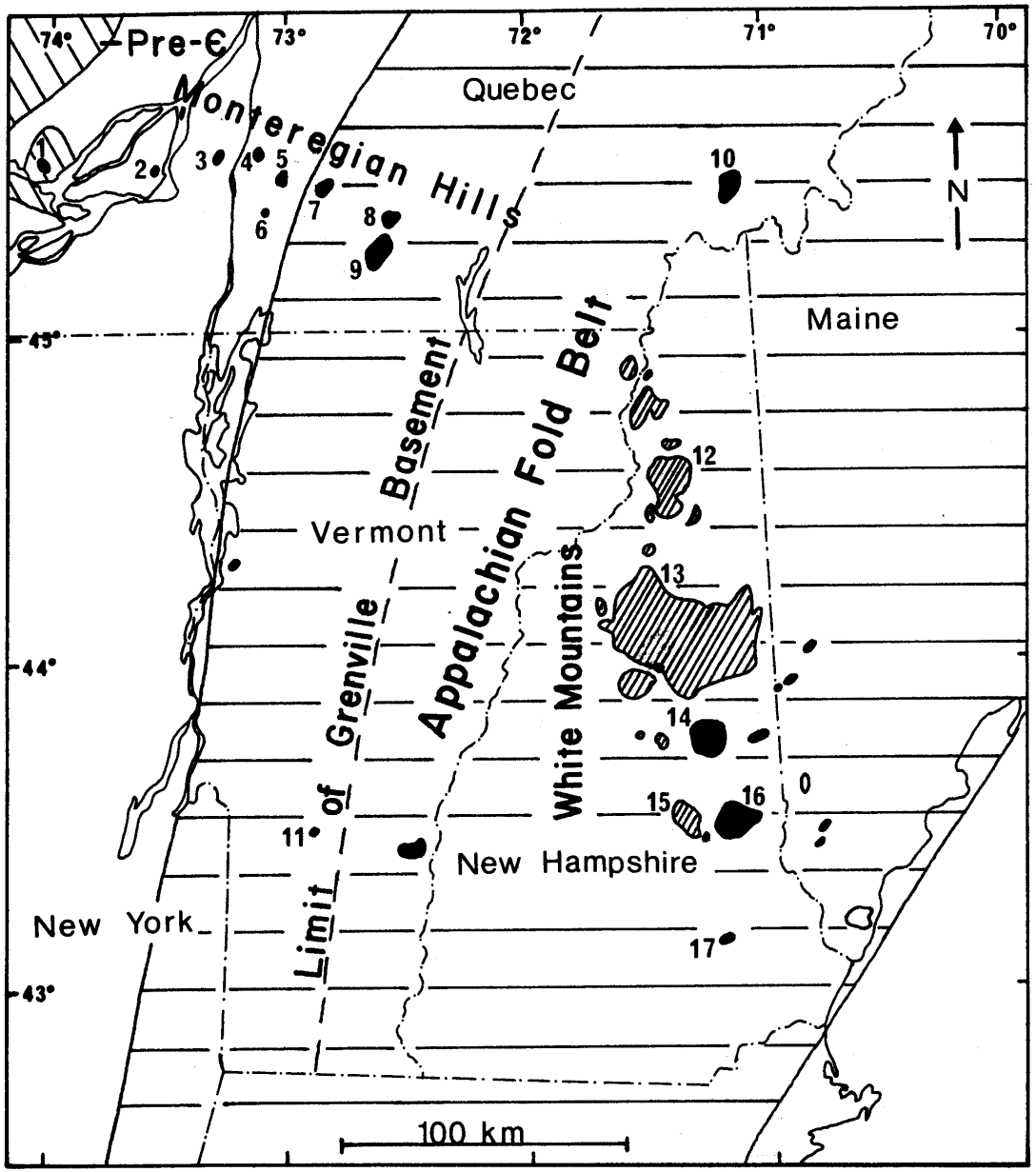


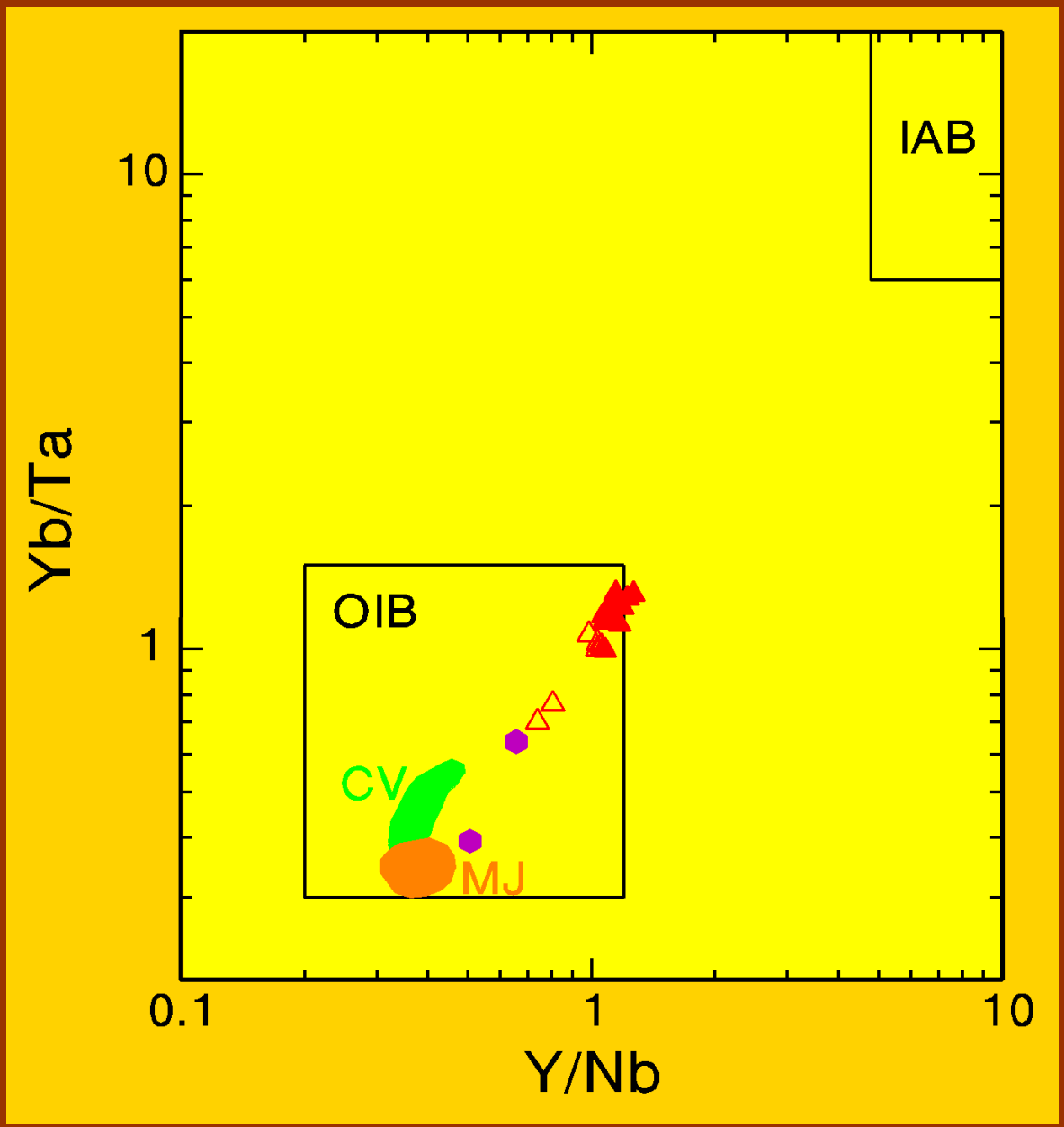
Cross-hatched plutons

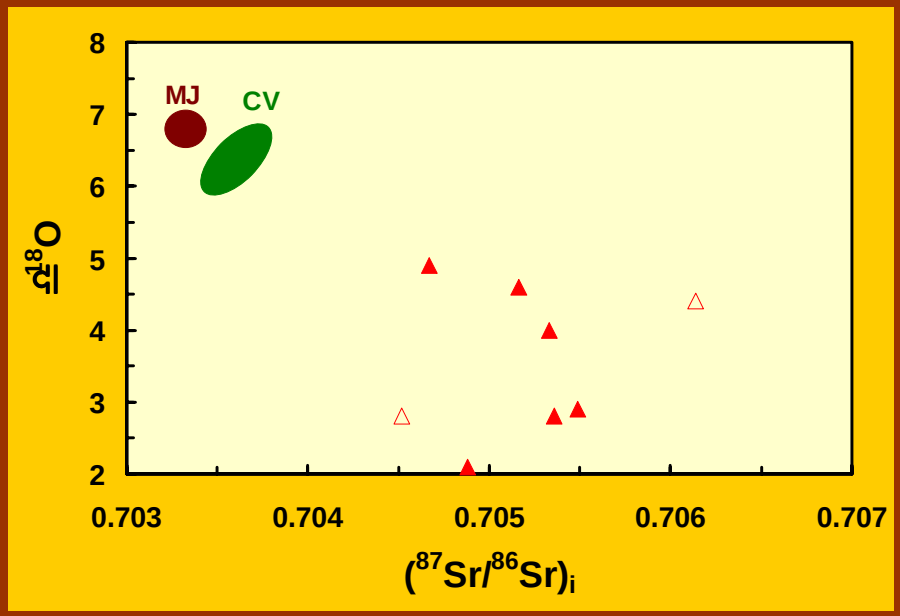
150 - 220 Ma

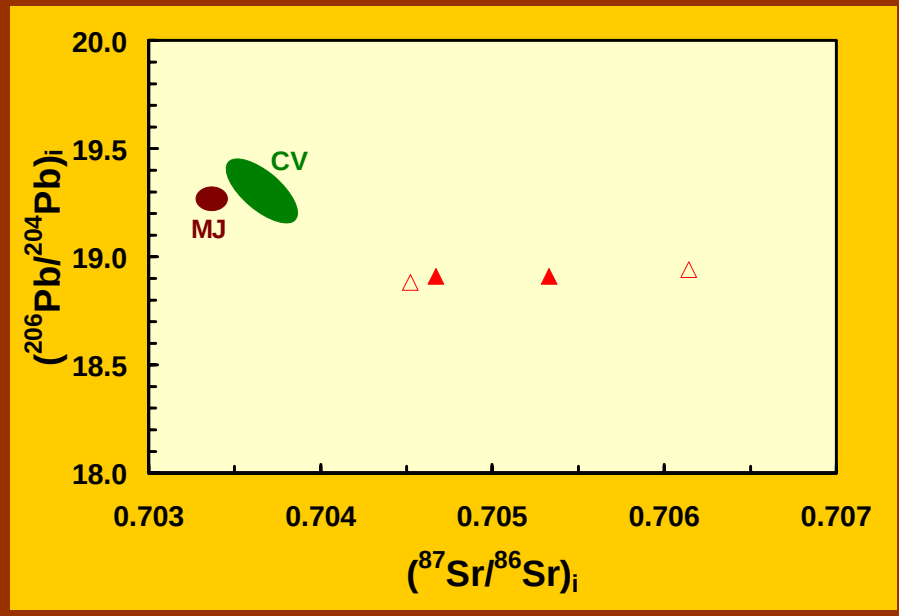
Filled plutons

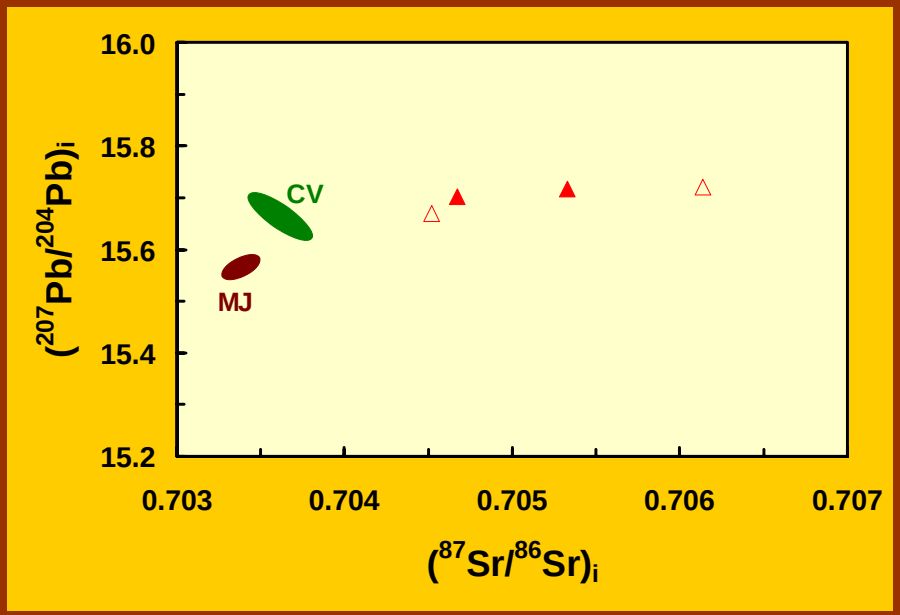
100 - 125 Ma

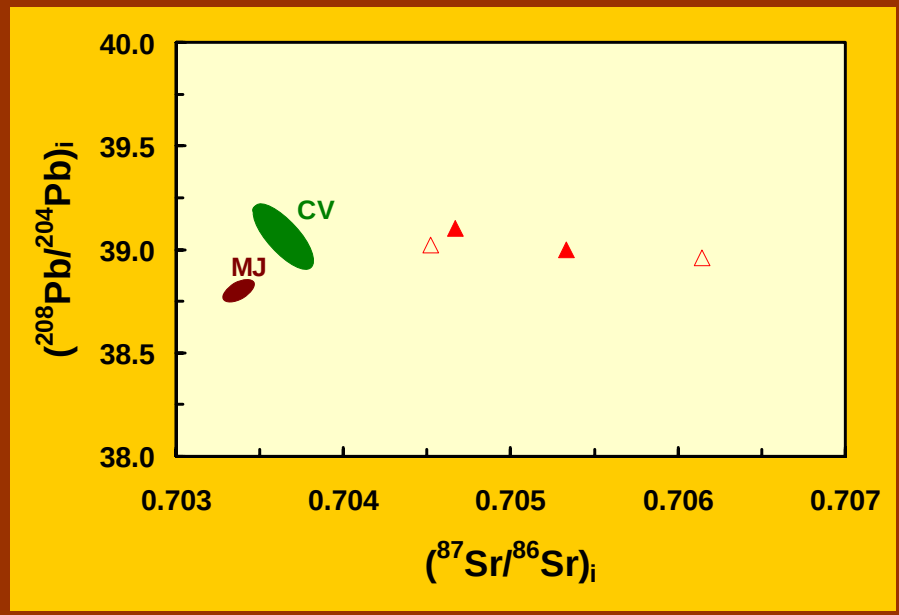
Y/Nb vs Yb/Ta discriminant diagram for magma sources




MJ
CV
8
7
6
5
4
3
2
0.703
0.704
0.705
0.706
0.707
$(^{87}Sr/^{86}Sr)_i$


CV
MJ
20.0
19.5
19.0
18.5
18.0
$(^{206}Pb/^{204}Pb)_i$
0.703
0.704
0.705
0.706
0.707
$(^{87}Sr/^{86}Sr)_i$


CV
MJ
16.0
15.8
15.6
15.4
15.2
$(^{207}Pb/^{204}Pb)_i$
0.703
0.704
0.705
0.706
0.707
$(^{87}Sr/^{86}Sr)_i$


CV
MJ
40.0
39.5
39.0
38.5
38.0
$(^{208}Pb/^{204}Pb)_i$
0.703
0.704
0.705
0.706
0.707
$(^{87}Sr/^{86}Sr)_i$

Conclusions

- Several groups of basalts and rhyolites can be chemically distinguished.
- Most melts were last at equilibrium at intermediate to deep levels.
- Magma differentiation largely occurred through fractionation of plagioclase and pyroxene, with minor crustal contamination.
- The basaltic magmas were derived from an OIB-like source.
- All the Monteregian Hills - White Mountain magmas were derived from similar sources. The White Mountain magmas are silica saturated because of magma-country rock interactions at deep levels in the continental crust.