PLIO-PLEISTOCENE VOLCANISM IN THE SOUTHERN BASIN-AND-RANGE PROVINCE: IMPLICATIONS FOR THE PROPOSED HIGH-LEVEL NUCLEAR WASTE REPOSITORY AT YUCCA MOUNTAIN, NEVADA

BY

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PURPOSE OF STUDIES DURING 1990

1. Source of basaltic magma

2. Ascent of magma from source to surface

3. Volcanic hazard assessment

TOPICS

1. Pb, Nd, and Sr isotopes - source of magma

2. Magma ascent

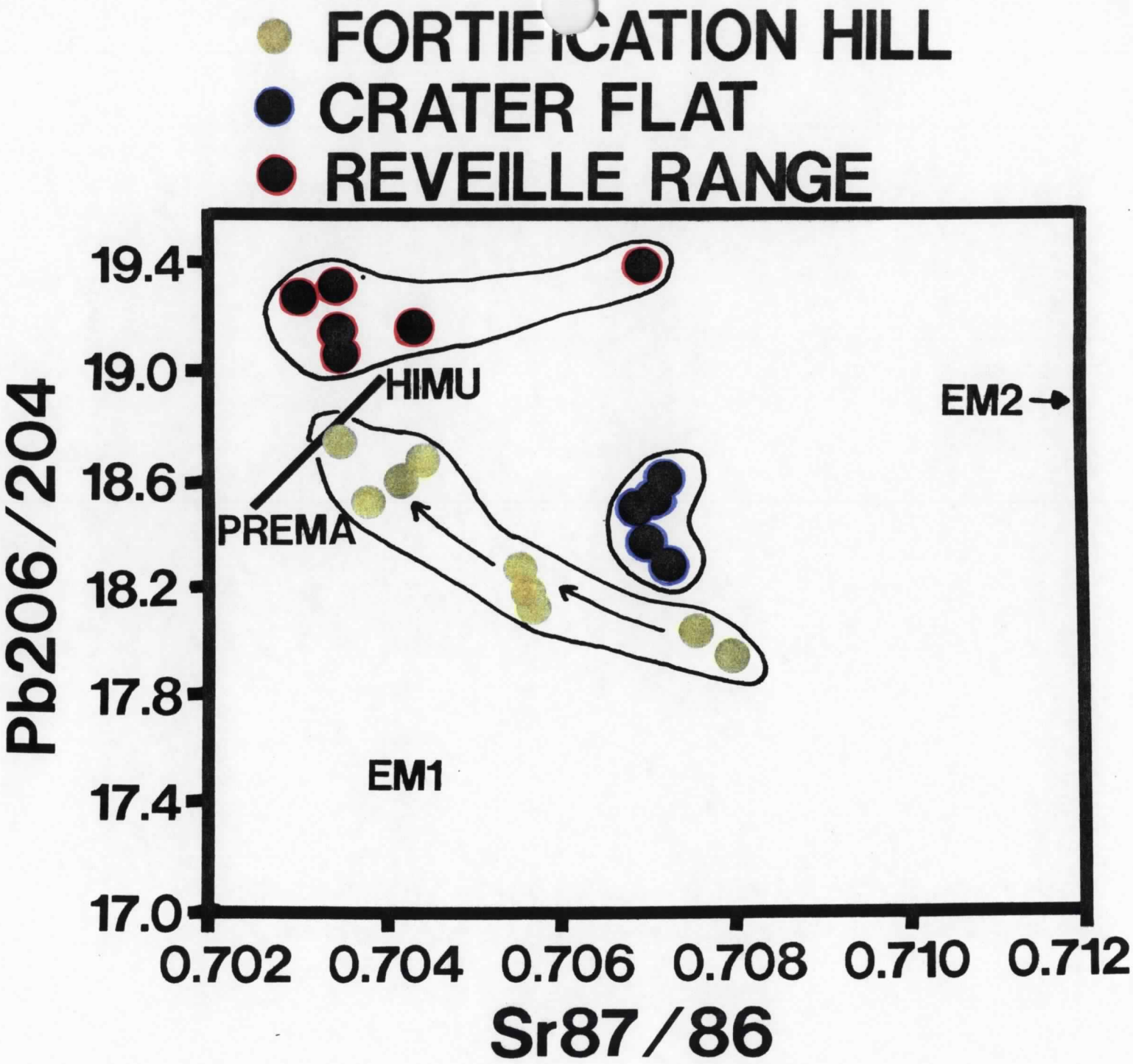
3. AMRV, Buckboard Mesa, and Risk Zones

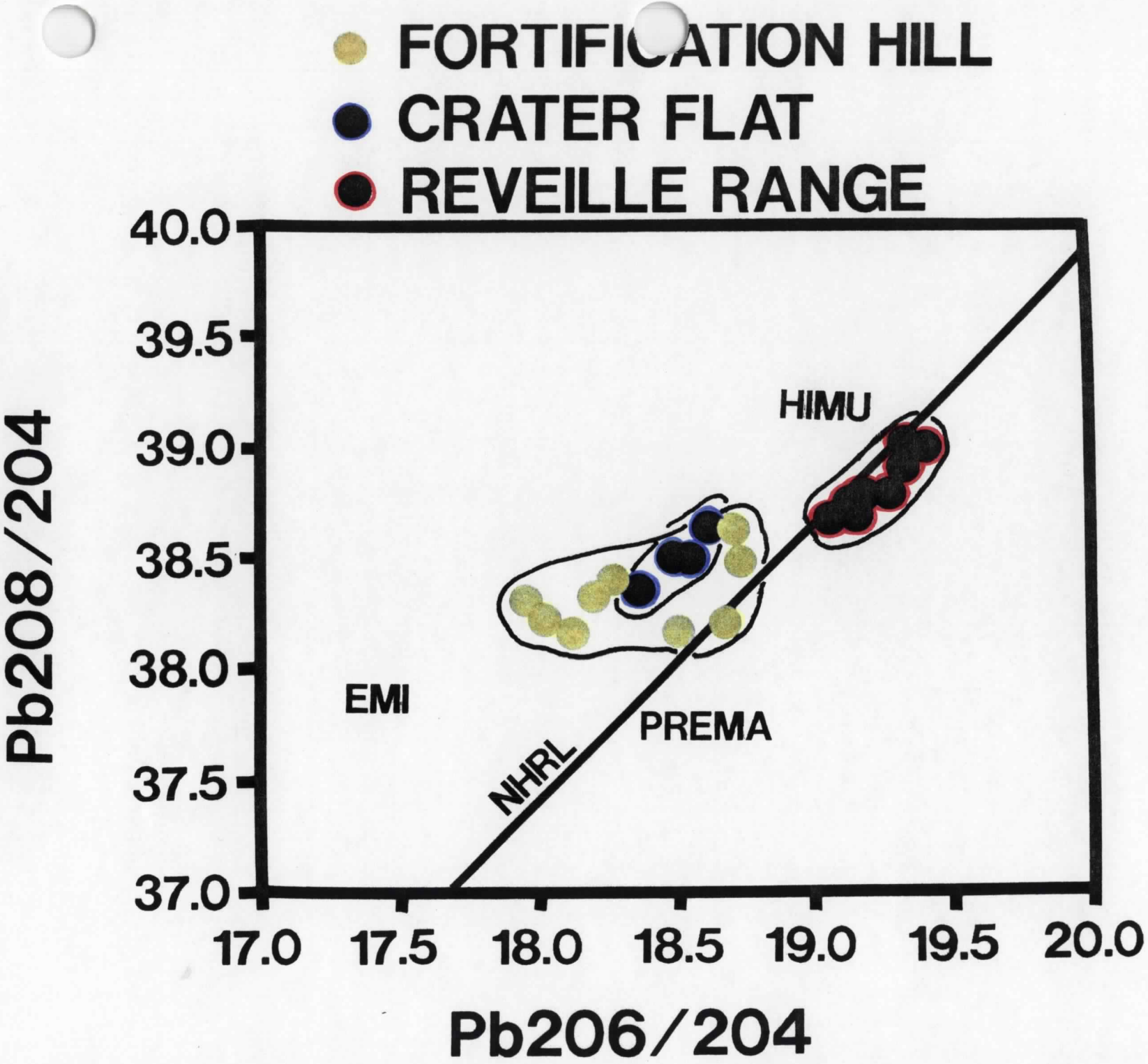
TOPICS

[redacted]

2. Magma ascent

3. AMRV, Buckboard Mesa, and Risk Zones


FORTIFICATION HILL
CRATER FLAT
REVEILLE RANGE
HIMU
EM2
PREMA
EM1
Pb206/204
19.4
19.0
18.6
18.2
17.8
17.4
17.0
0.702
0.704
0.706
0.708
0.710
0.712
Sr87/86


FORTIFICATION HILL
CRATER FLAT
REVEILLE RANGE
40.0
39.5
39.0
38.5
38.0
37.5
37.0
Pb208/204
HIMU
EMI
PREMA
NHRL
17.0
17.5
18.0
18.5
19.0
19.5
20.0
Pb206/204

ISOTOPIC STUDIES

1. Crater Flat - lithospheric mantle (Farmer et al., 1989).

2. Reveille Range - lithospheric mantle (HIMU).

3. Fortification Hill - lithospheric mantle to a mixture of asthenosphere and HIMU with time. Lithospheric erosion?

TOPICS

1. Pb, Nd, and Sr isotopes - source of magma

[redacted]

3. AMRV, Buckboard Mesa, and Risk Zones

VOLCANISM AND EXTENSION MODEL ASSUMPTIONS

(1) detachment faults nucleate at high angle and later rotate to low angle due to footwall rebound (Buck, 1988; Wernicke and Axen, 1988).

(2) detachment faults may root into ductile shear zones in the lower crust.

(3) upper crustal extension in areas thermally weakened by magmatism.

(4) magmas rise through faults and/or joints to the upper crust and surface.

FORTIFICATION HILL VOLCANIC FIELD

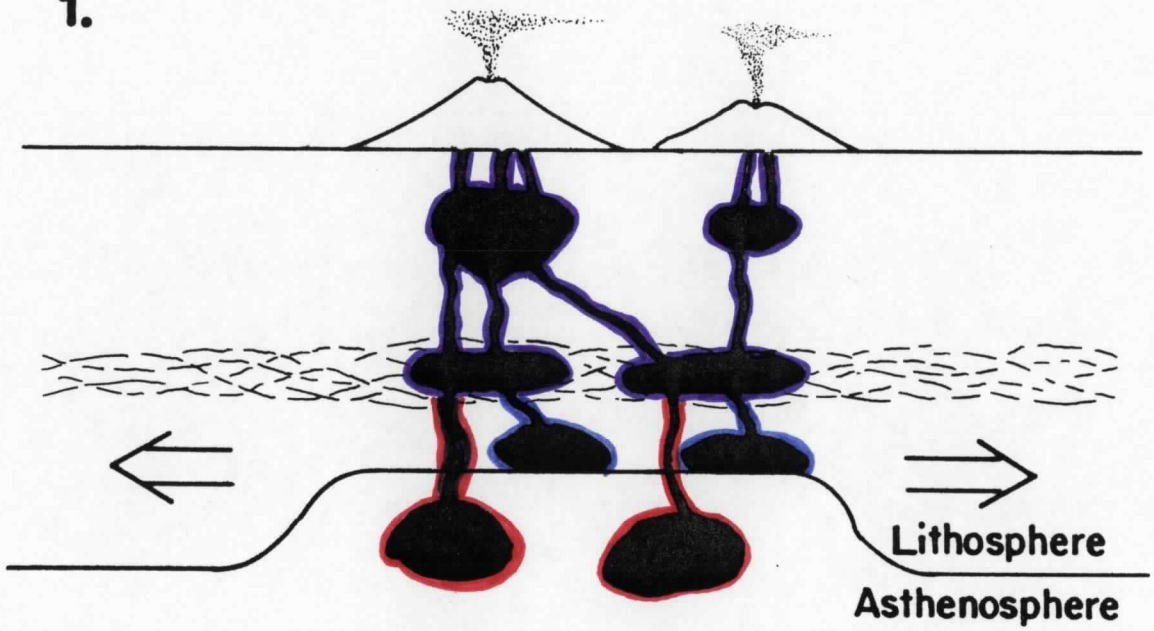
PHASE 1 (18-12 Ma) Calc-alkaline intermediate magmatism, ductile extension in the lower crust

PHASE 2 (12 Ma) rhyolite and basalt flows, numerous dikes, first evidence of upper crustal extension

PHASE 3 (12-9 Ma) Major phase of upper crustal extension. Magmatism wanes

PHASE 4 (7 to 4.7 Ma) High-angle faults cut the detachment. Basaltic volcanism

1.



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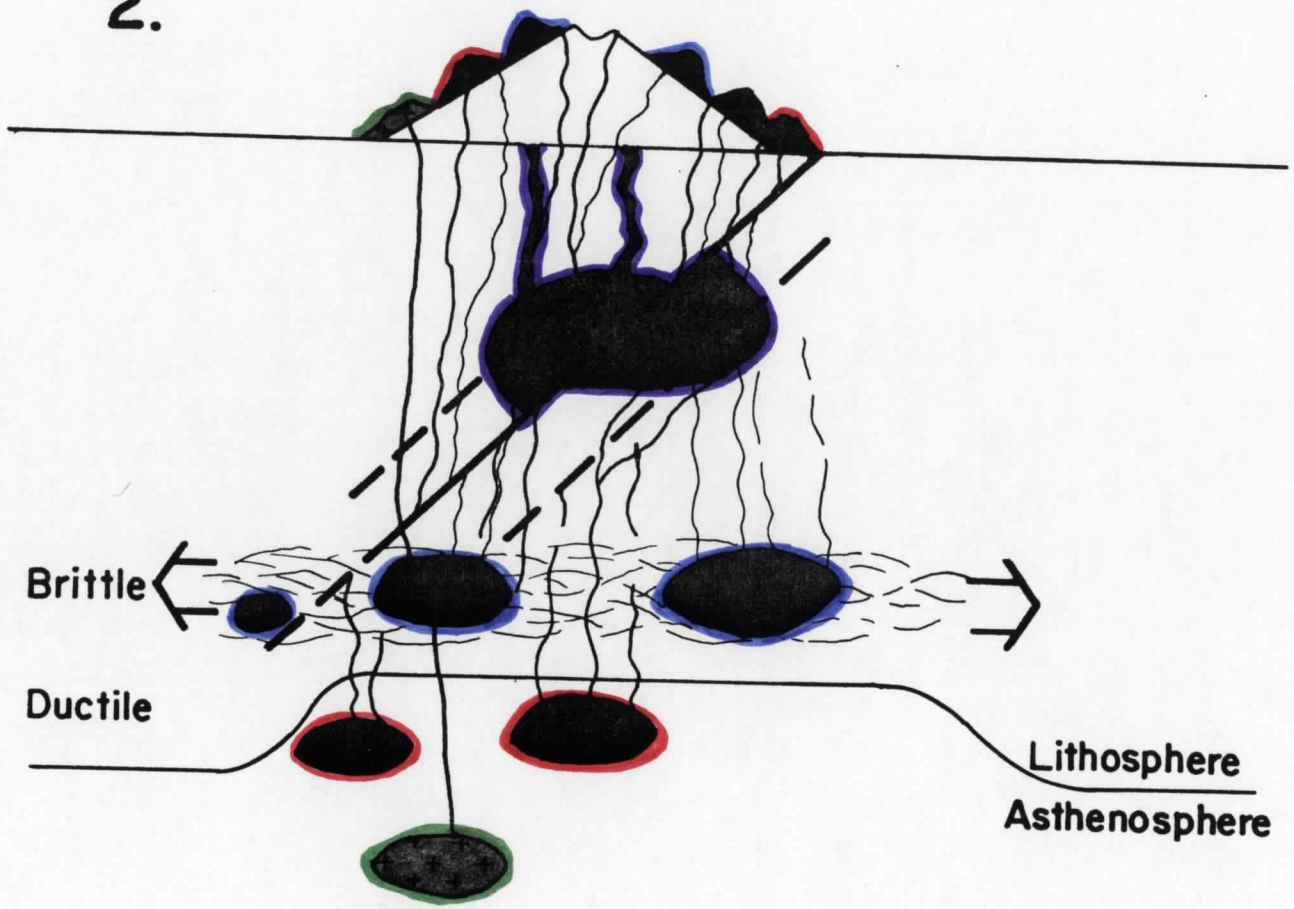

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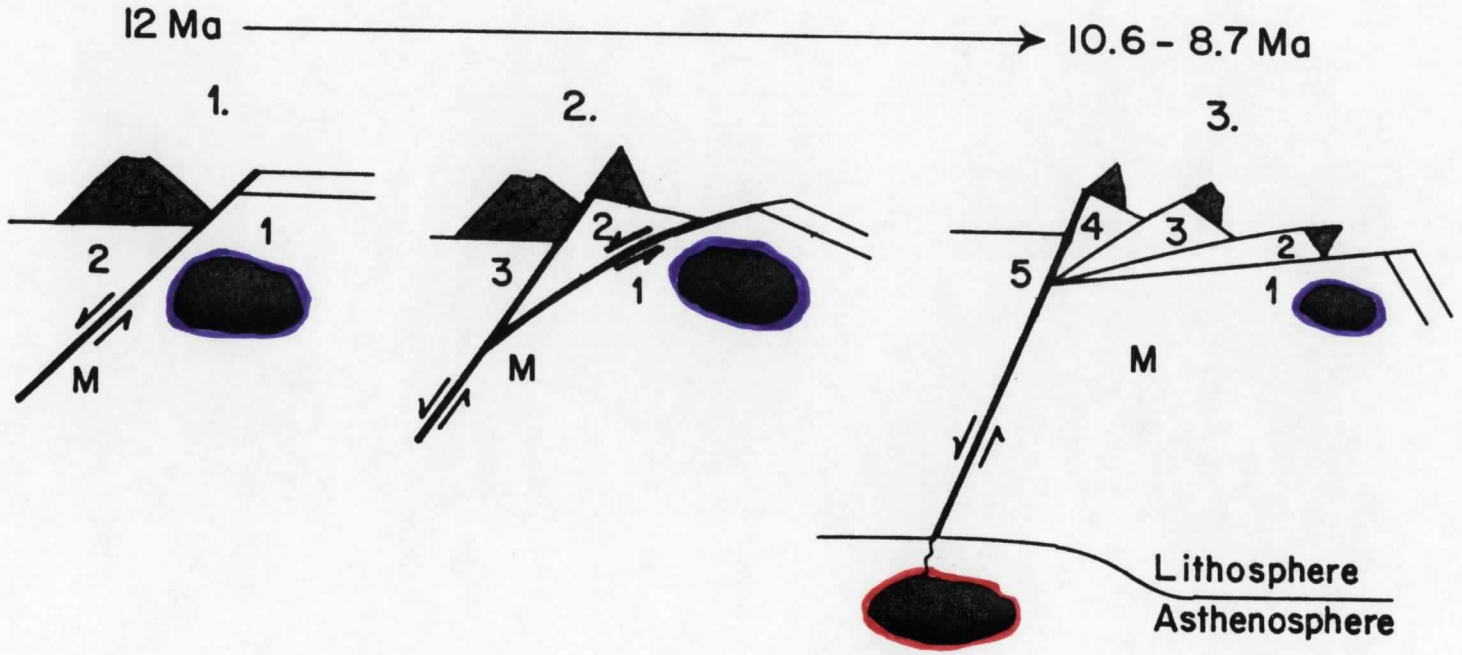
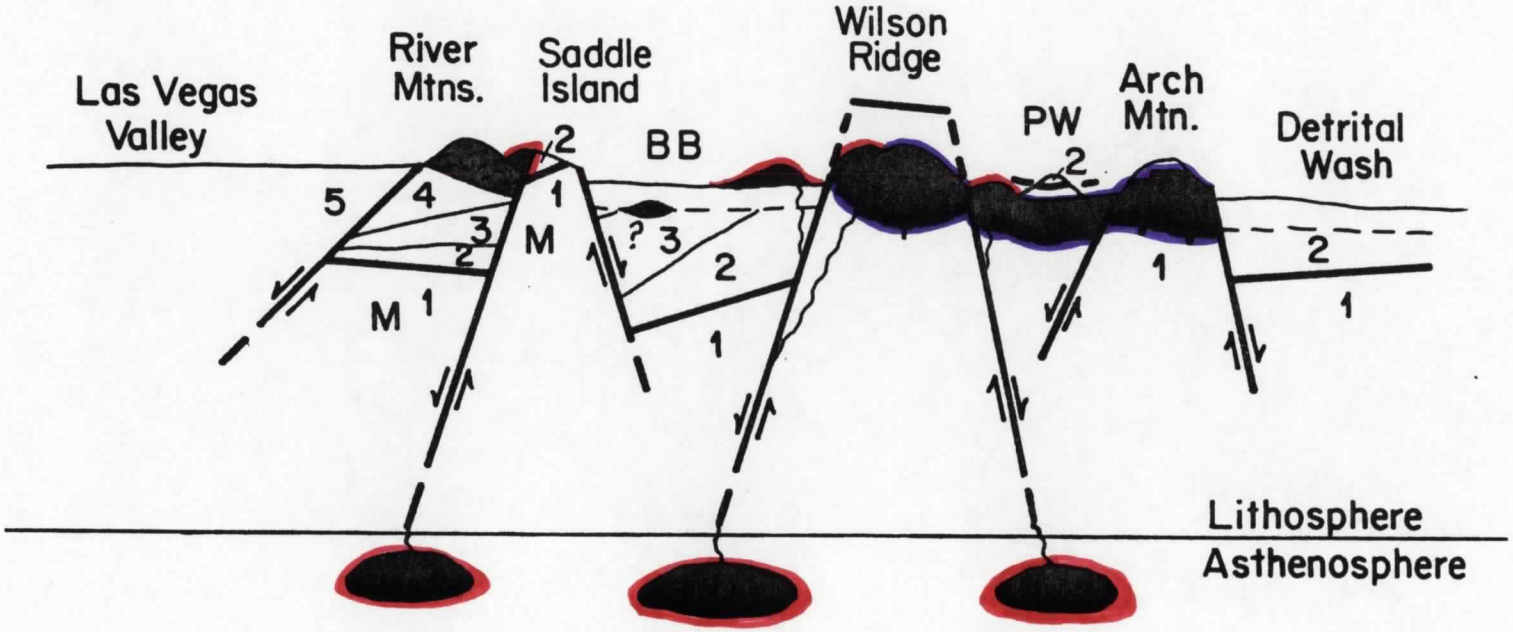

12 Ma
10.6 - 8.7 Ma
1.
2.
3.
1
2
M
1
2
3
M
1
2
3
4
5
M
Lithosphere
Asthenosphere

4.


Las Vegas Valley
River Mtns.
Saddle Island
Wilson Ridge
Arch Mtn.
Detrital Wash
BB
PW
5
4
3
2
1
M
?
Lithosphere
Asthenosphere

VOLCANISM AND EXTENSION CONCLUSION

Alkalic basalts associated with high-angle faults that penetrate deep into the crust.

IMPLICATIONS FOR YUCCA MOUNTAIN

1. Alkali basalts in the AMRV controlled by crustal penetrating structures.

1. High angle segment of a detachment fault
2. Strike-slip fault
3. High-angle fault zone that cuts Yucca Mountain may represent a major crustal structure

DISTRIBUTION OF VOLCANOES IS NOT RANDOM; STRUCTURAL CONTROL MUST BE CONSIDERED IN PROBABILITY MODELS

TOPICS

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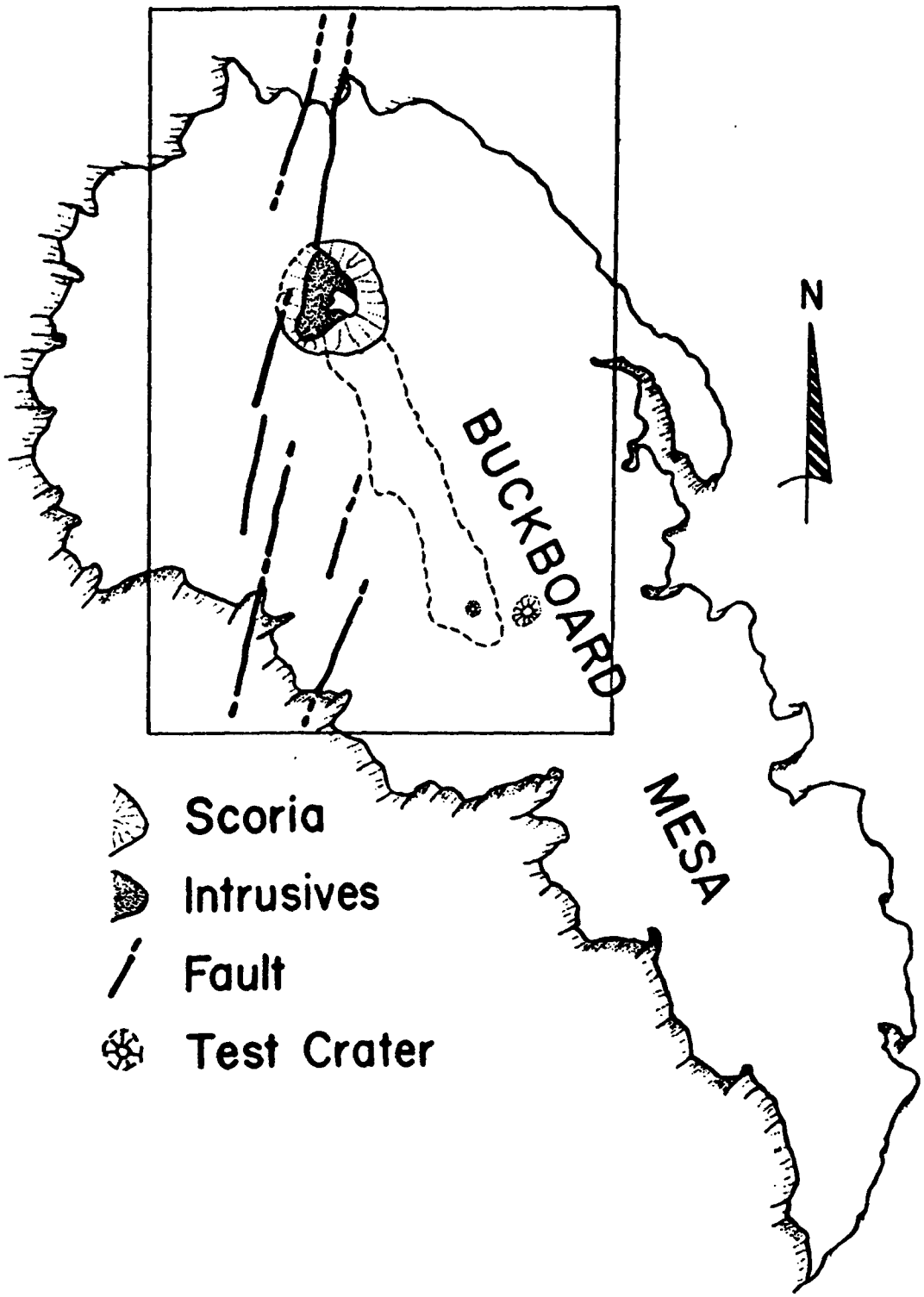
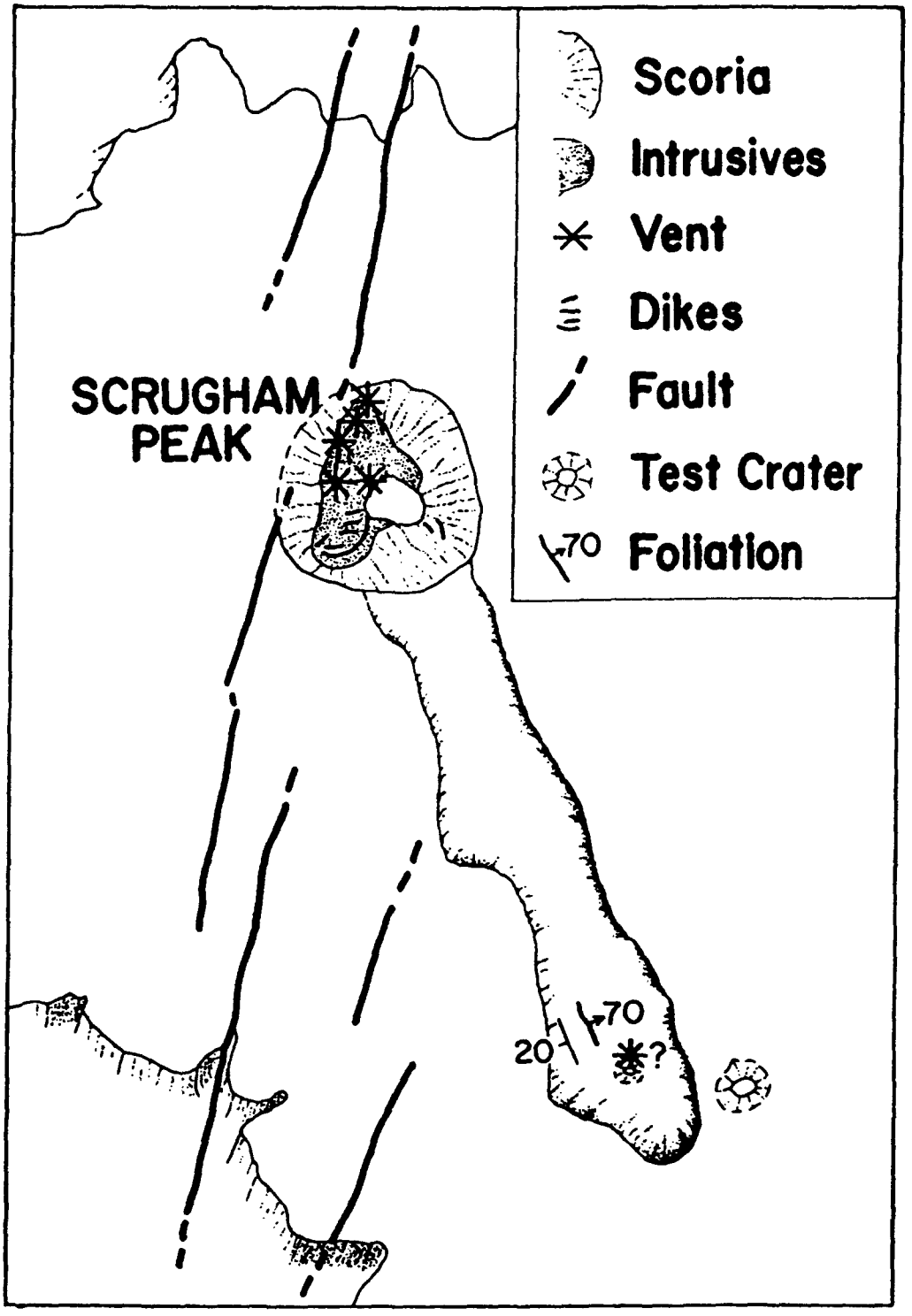
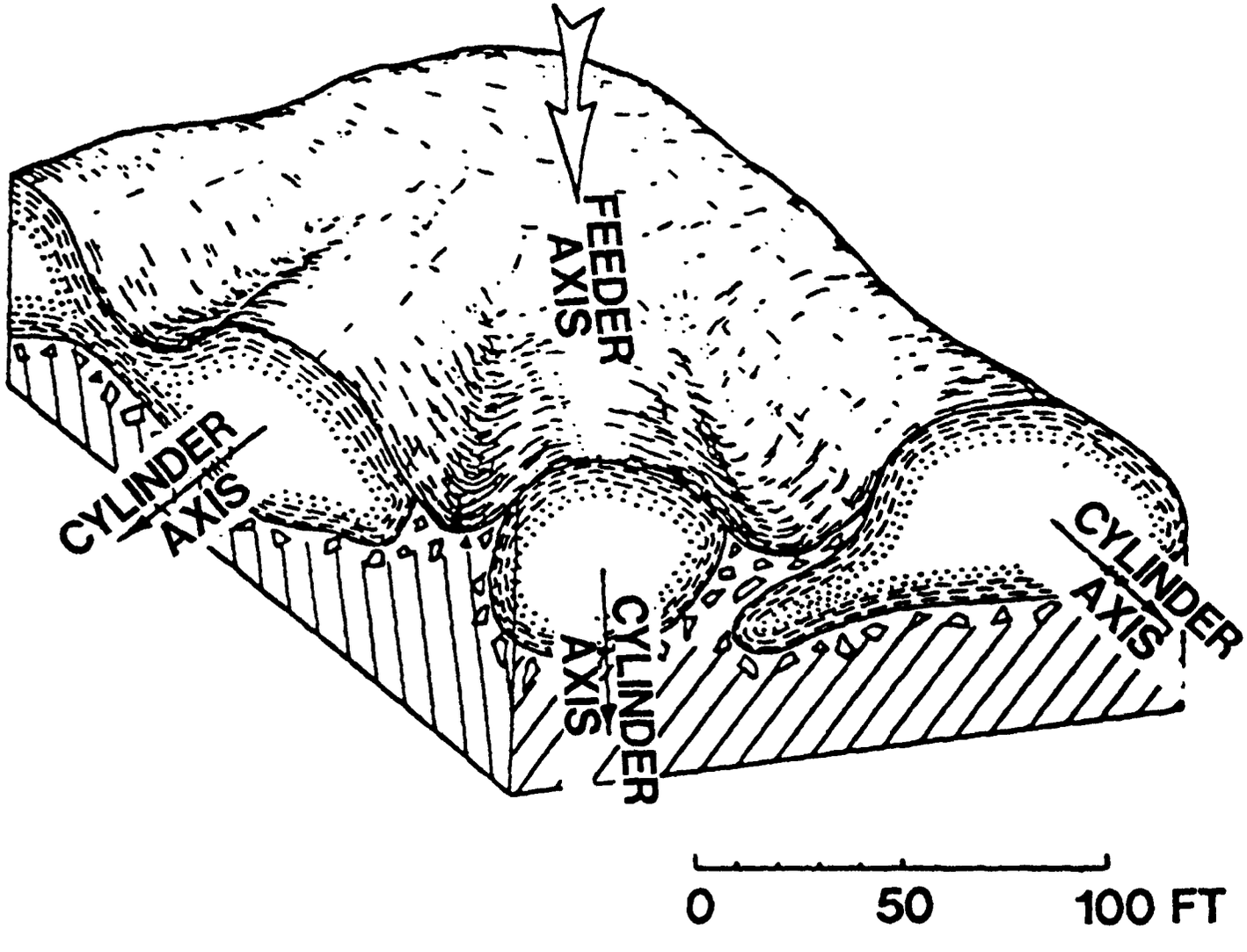

BUCKBOARD
MESA
N
Scoria
Intrusives
Fault
Test Crater


Scoria
Intrusives
Vent
Dikes
Fault
Test Crater
70
Foliation
SCRUGHAM PEAK
70
20
?

From R.J. Lutton (1969)



BUCKBOARD MESA/AMRV

1. Northeast striking structures control the location of vents.

2. Similar isotopic composition and source.

3. Similar in mineralogy and chemistry (quartz xenocrysts).

4. An event 2.8 m.y. ago; 33 km from Yucca Mountain.

SUMMARY

1. Source for alkali basalt magma is deep in lithosphere and/or asthenosphere.

2. Magma rises along crustal penetrating structures

3. In upper crust magma may:

   a. leave channelways and intrude hanging or foot wall

   b. target existing vent

   c. rise along a northeast fault segment

   d. follow upper-crustal structures (possibly with a different orientation than the master structure).