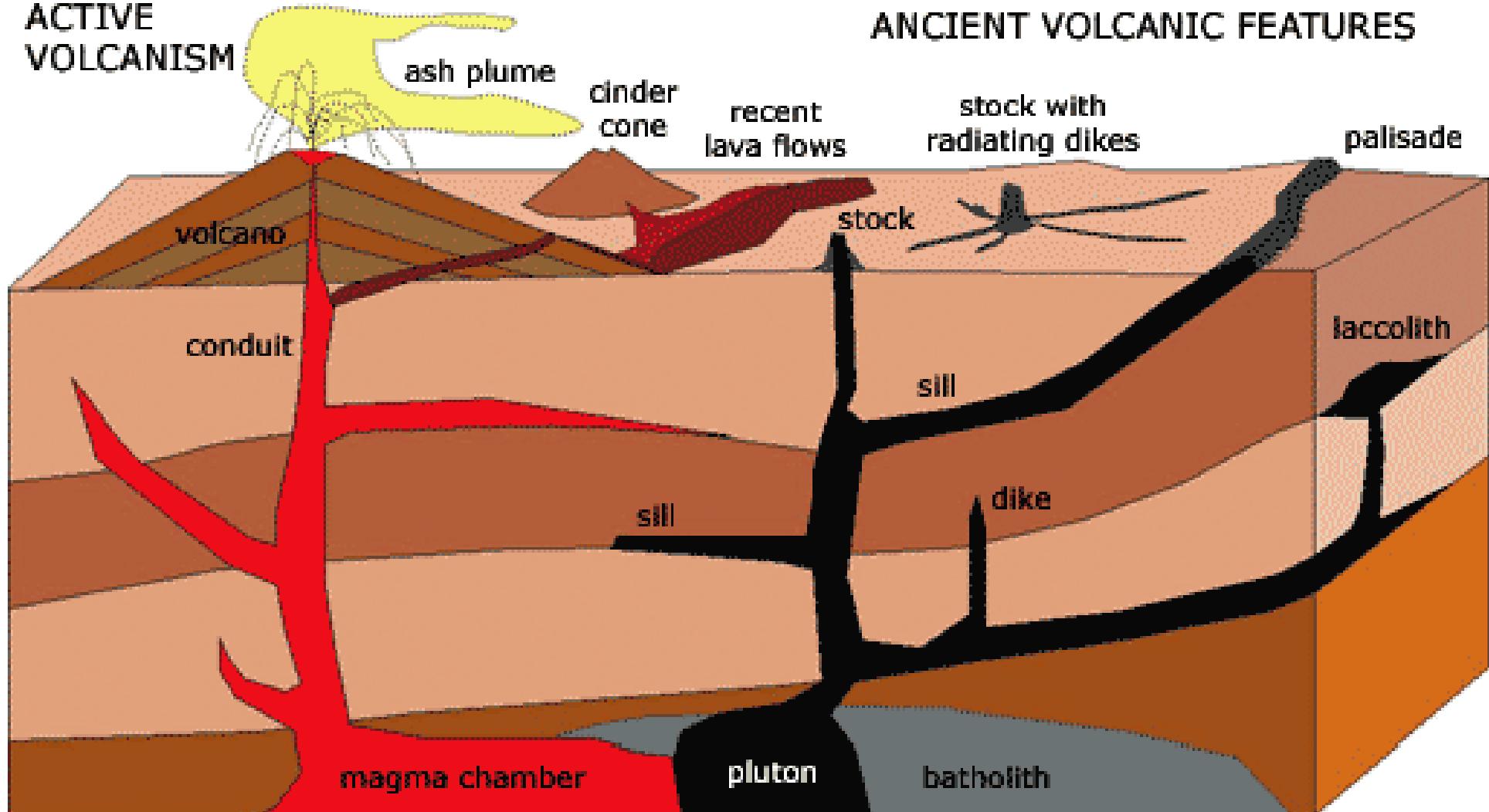
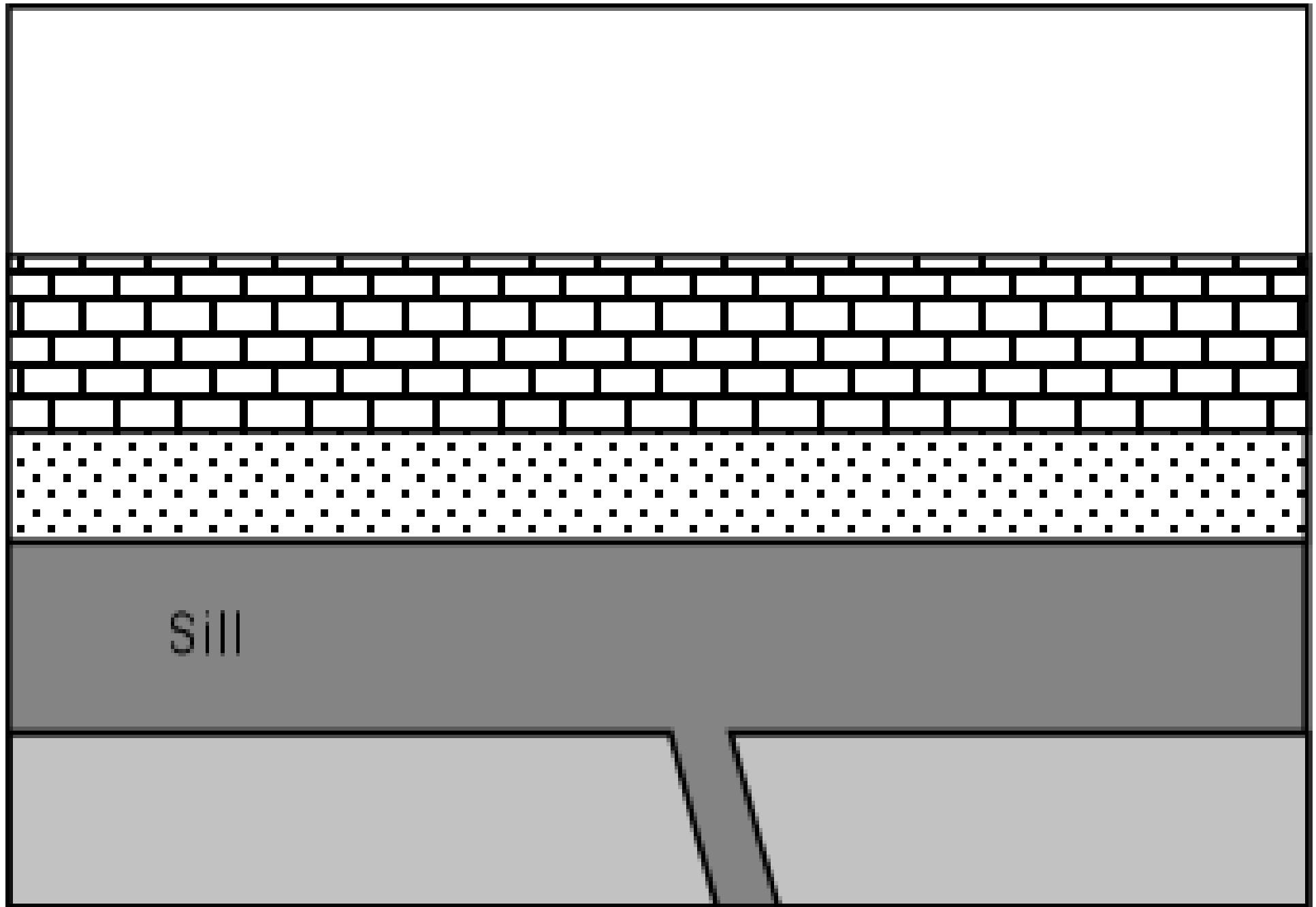


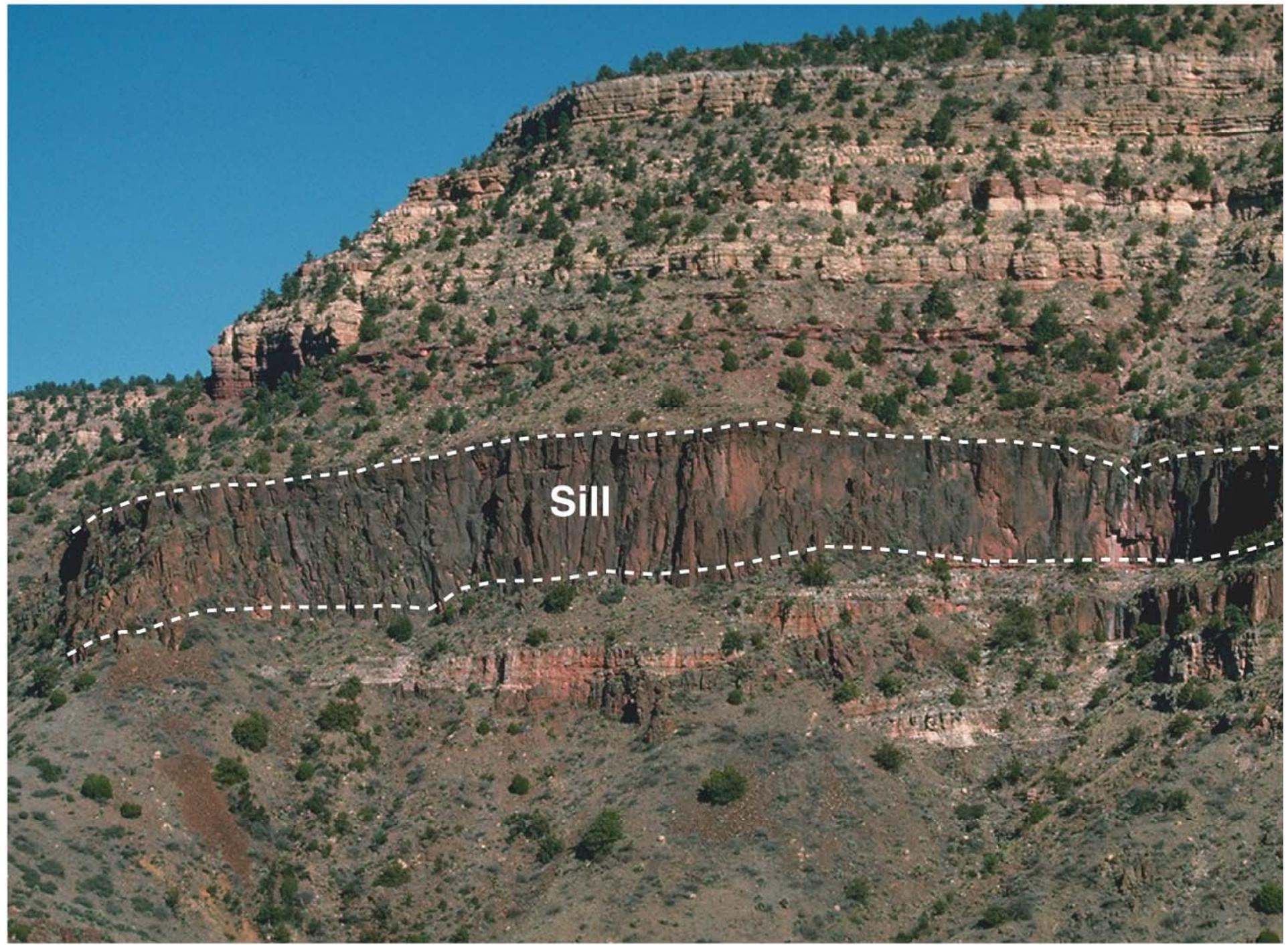
Intrusive Igneous Processes Mineral Resources

ACTIVE VOLCANISM

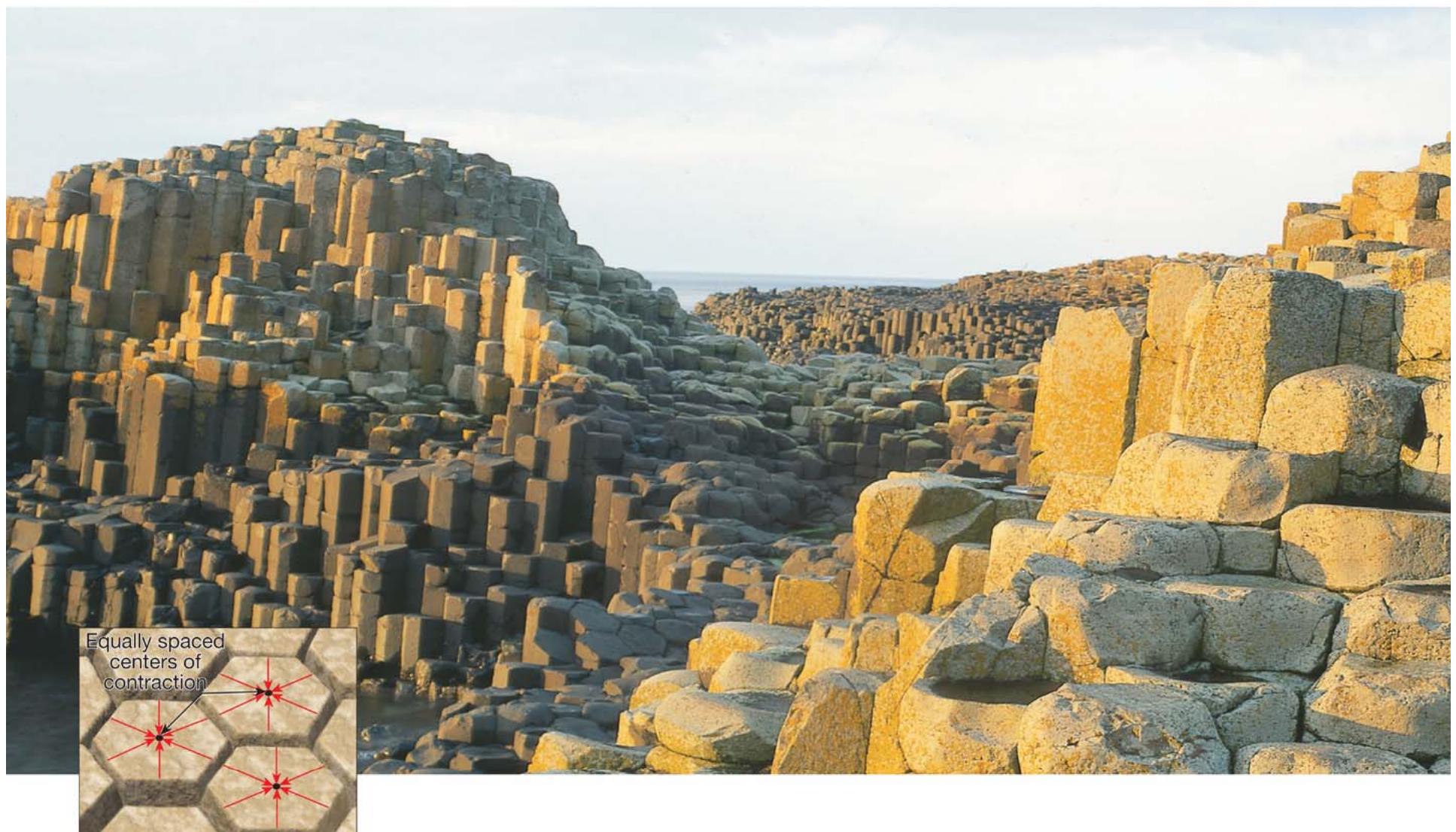
ANCIENT VOLCANIC FEATURES





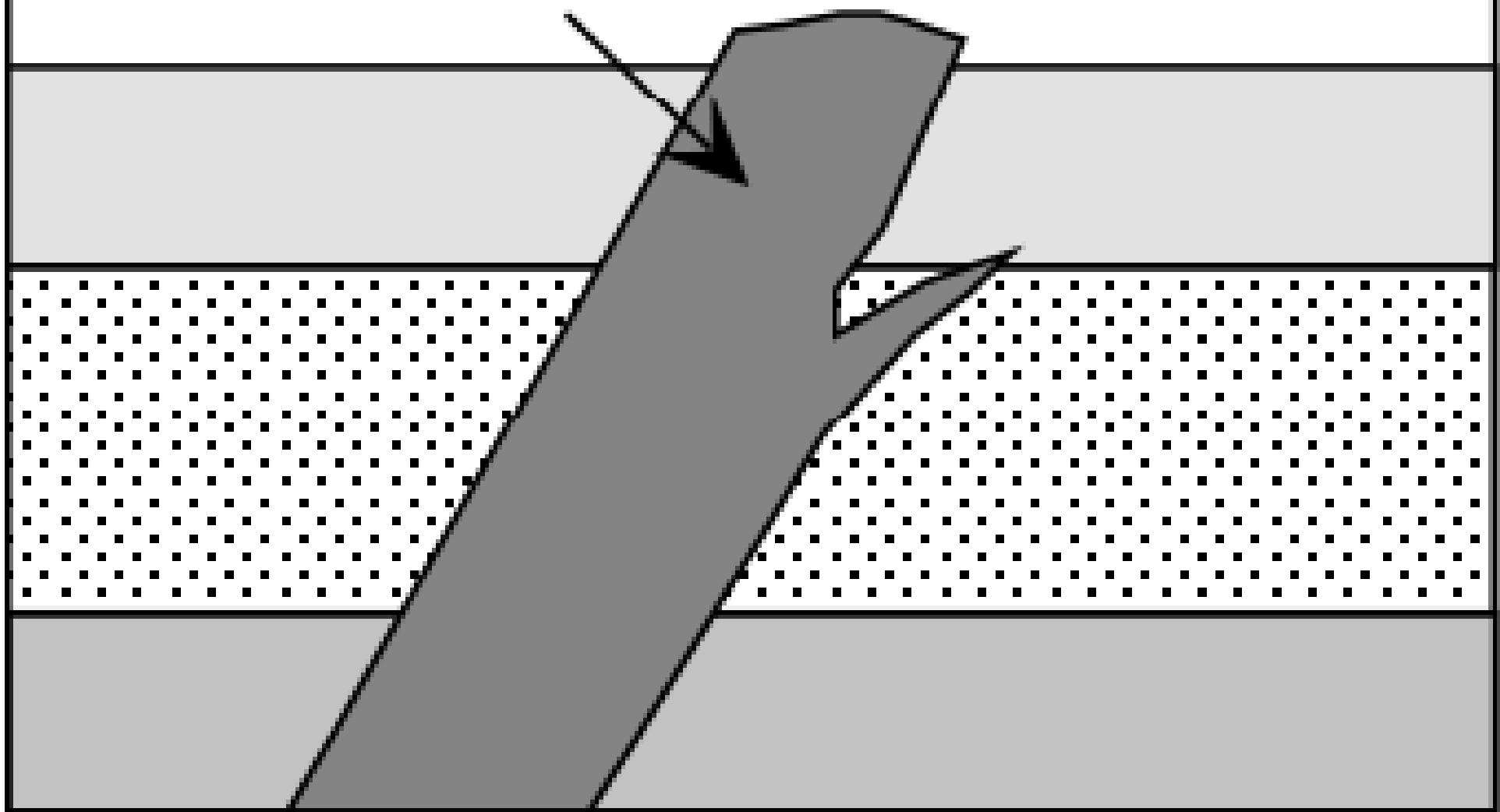


Sill



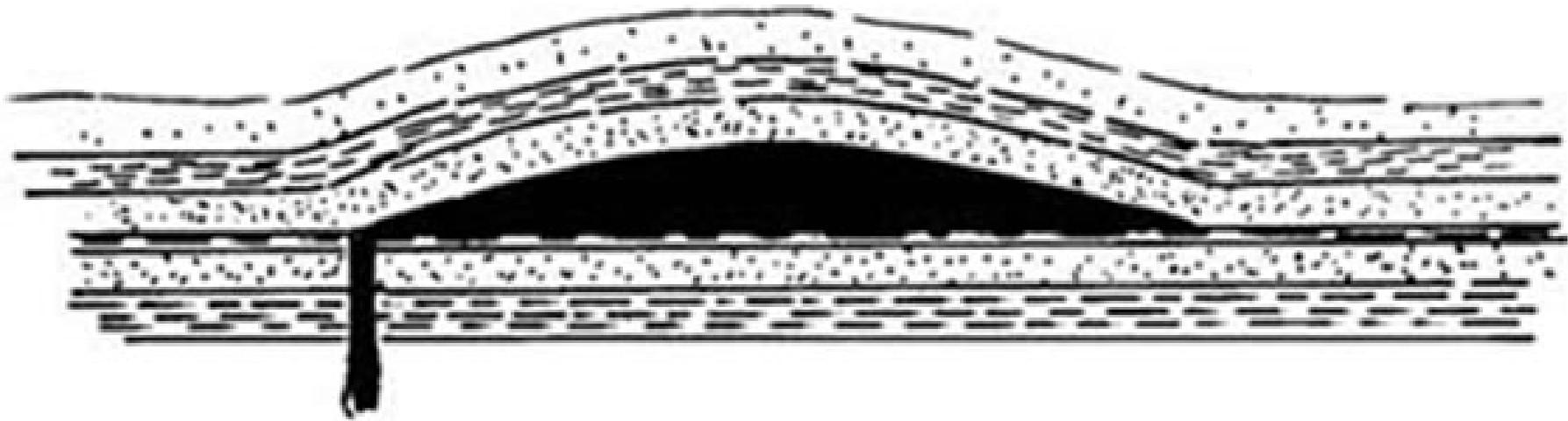
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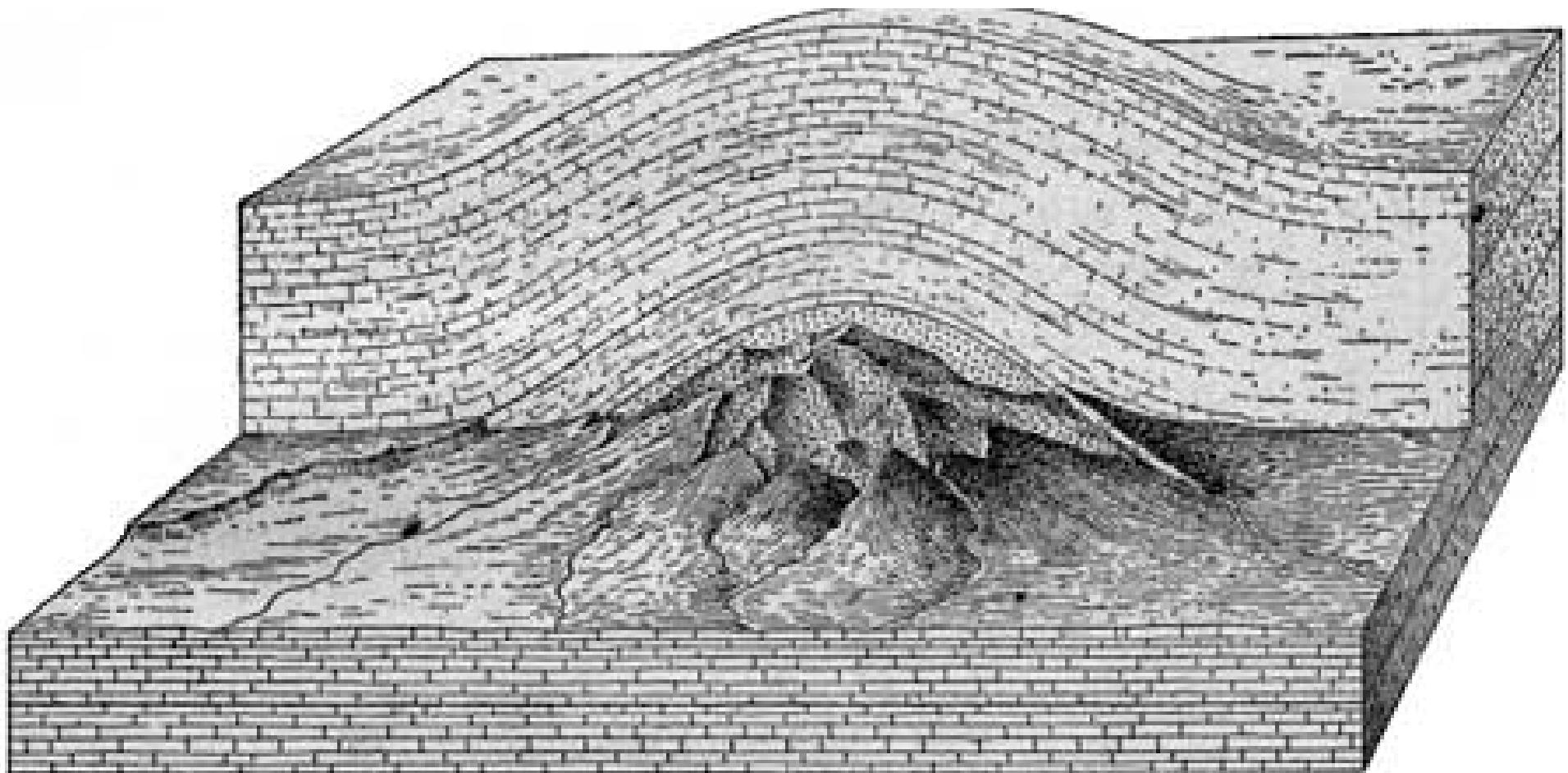
Dike





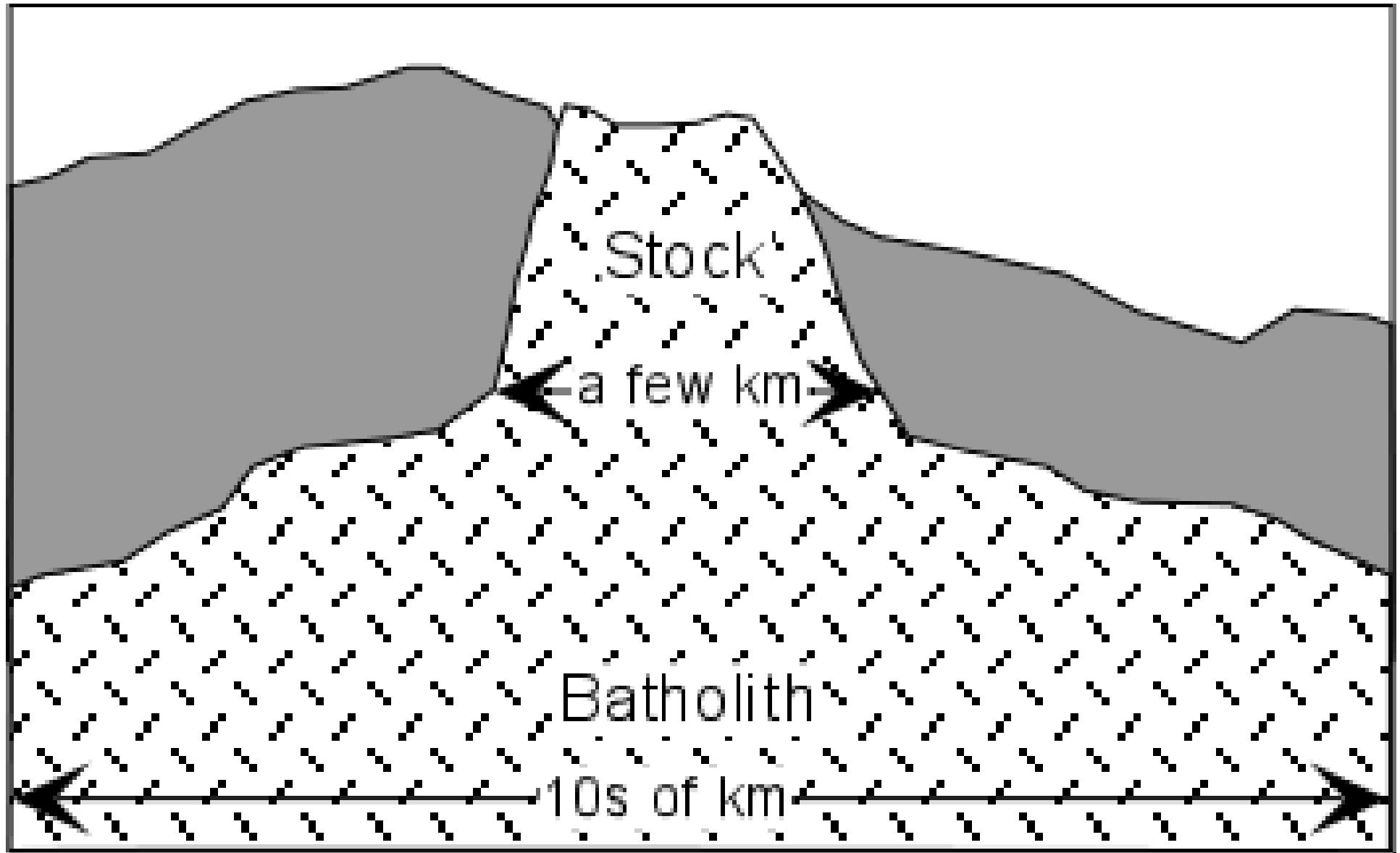
Laccolith

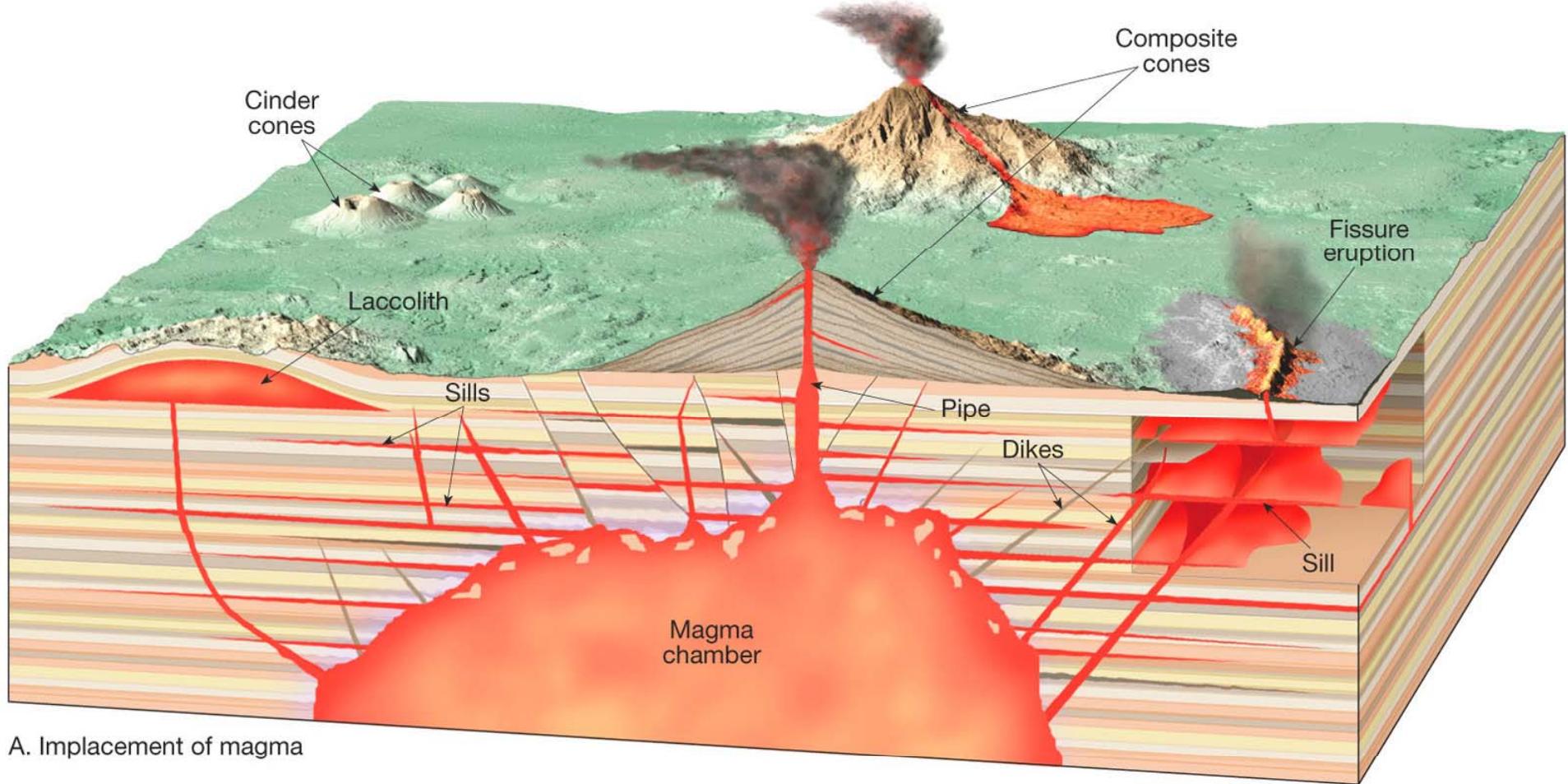






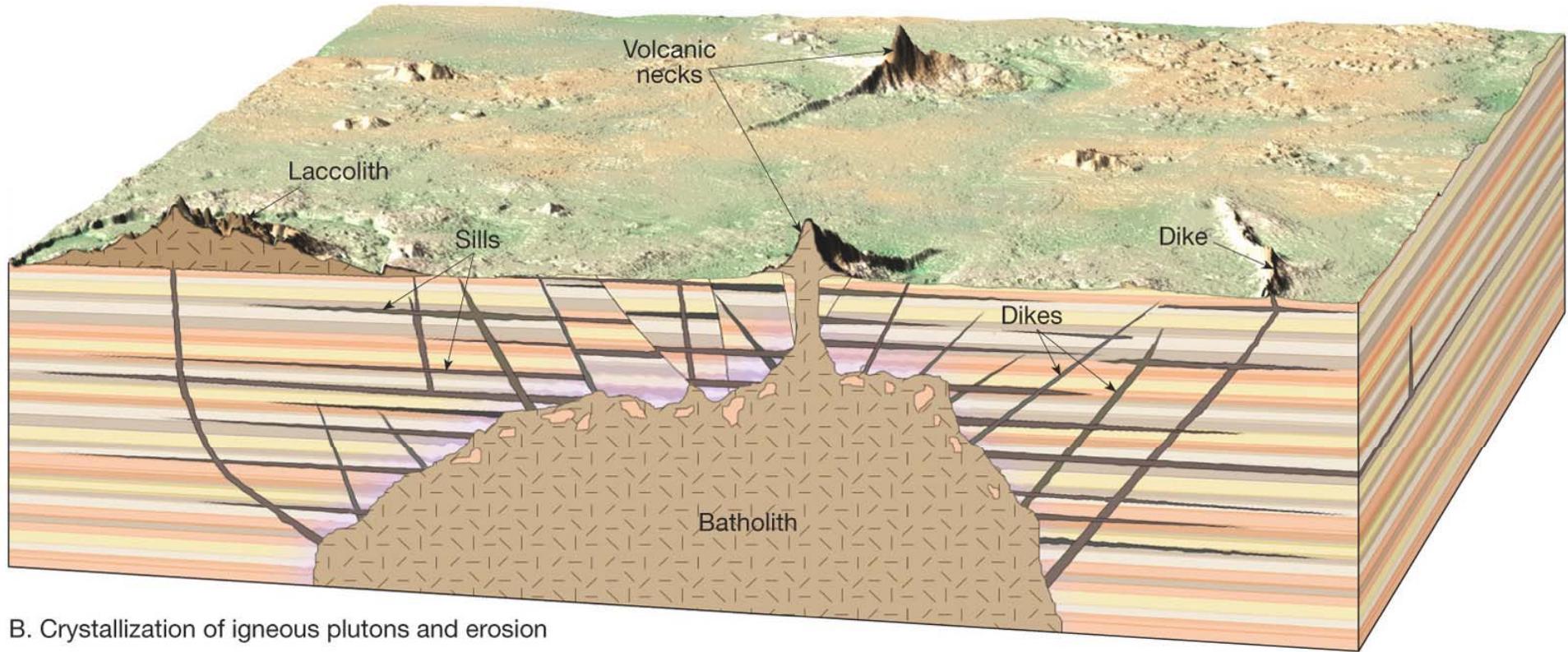
<http://www.fone.net/~rfrankd/UteMountain2.htm>





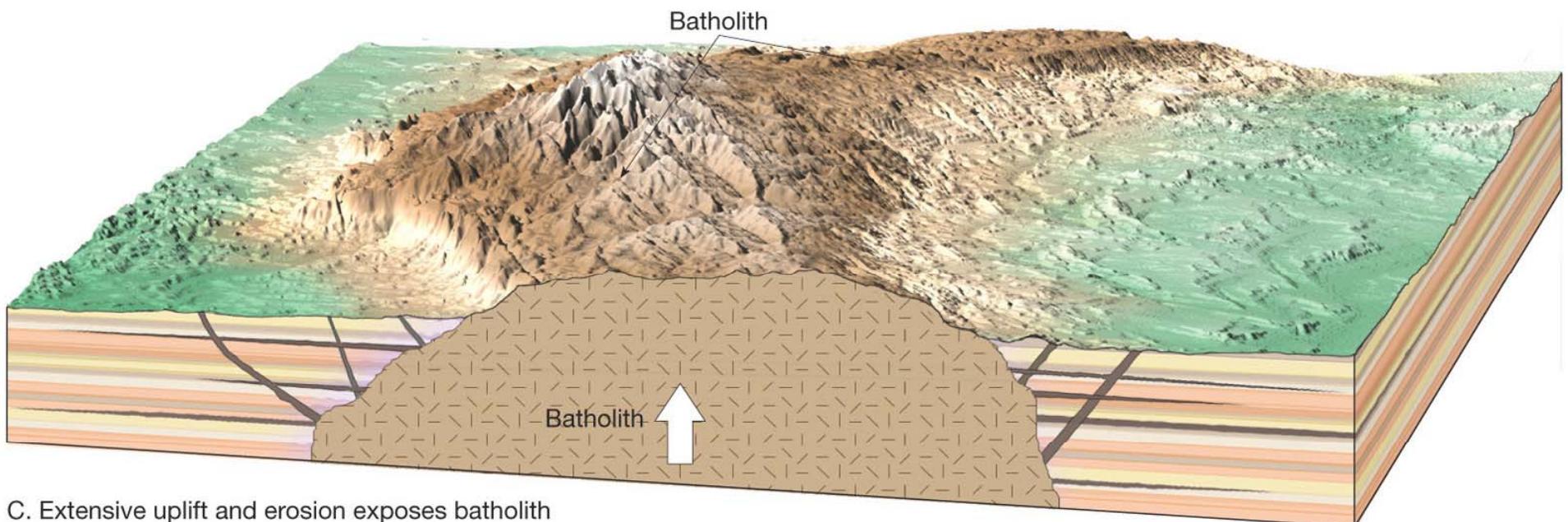
A. Implacement of magma

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B. Crystallization of igneous plutons and erosion

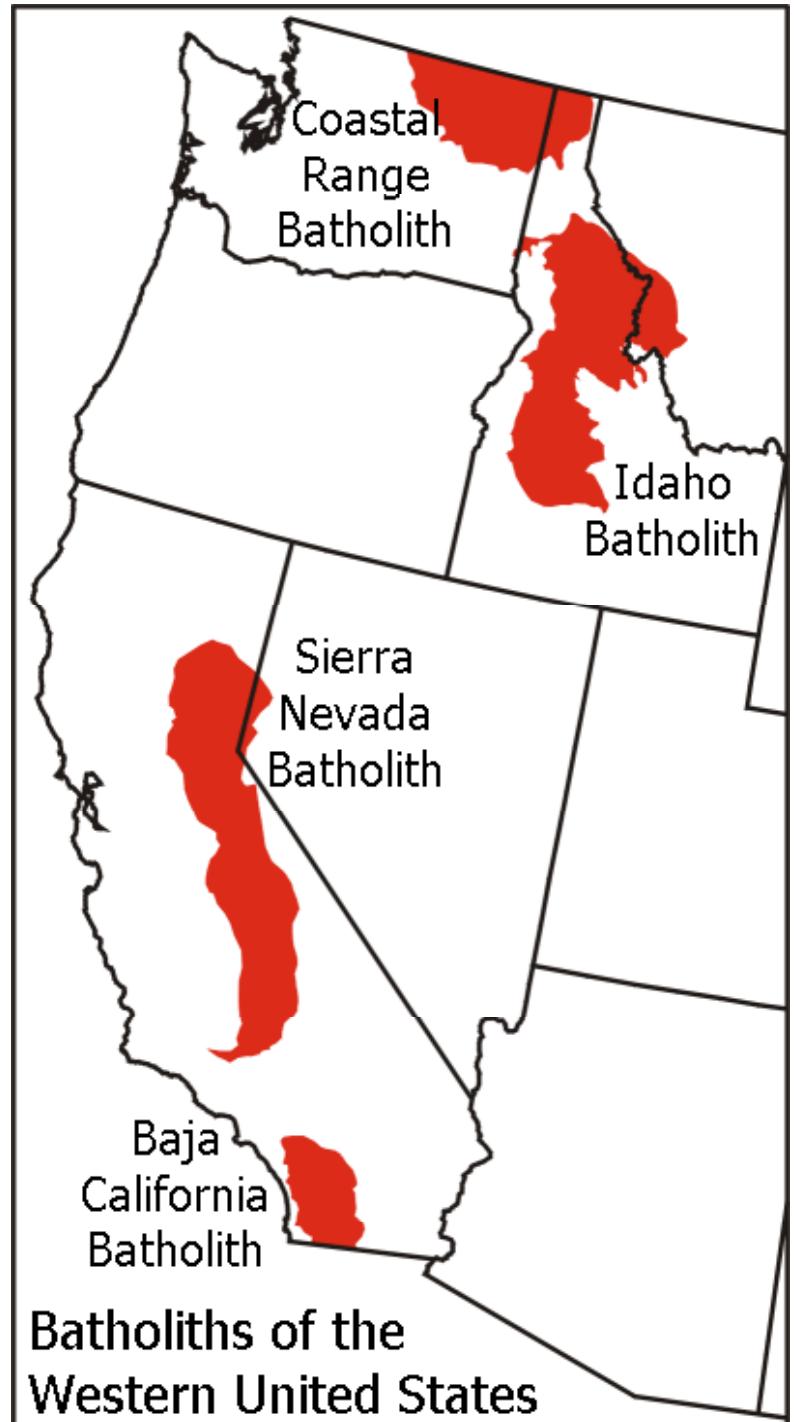
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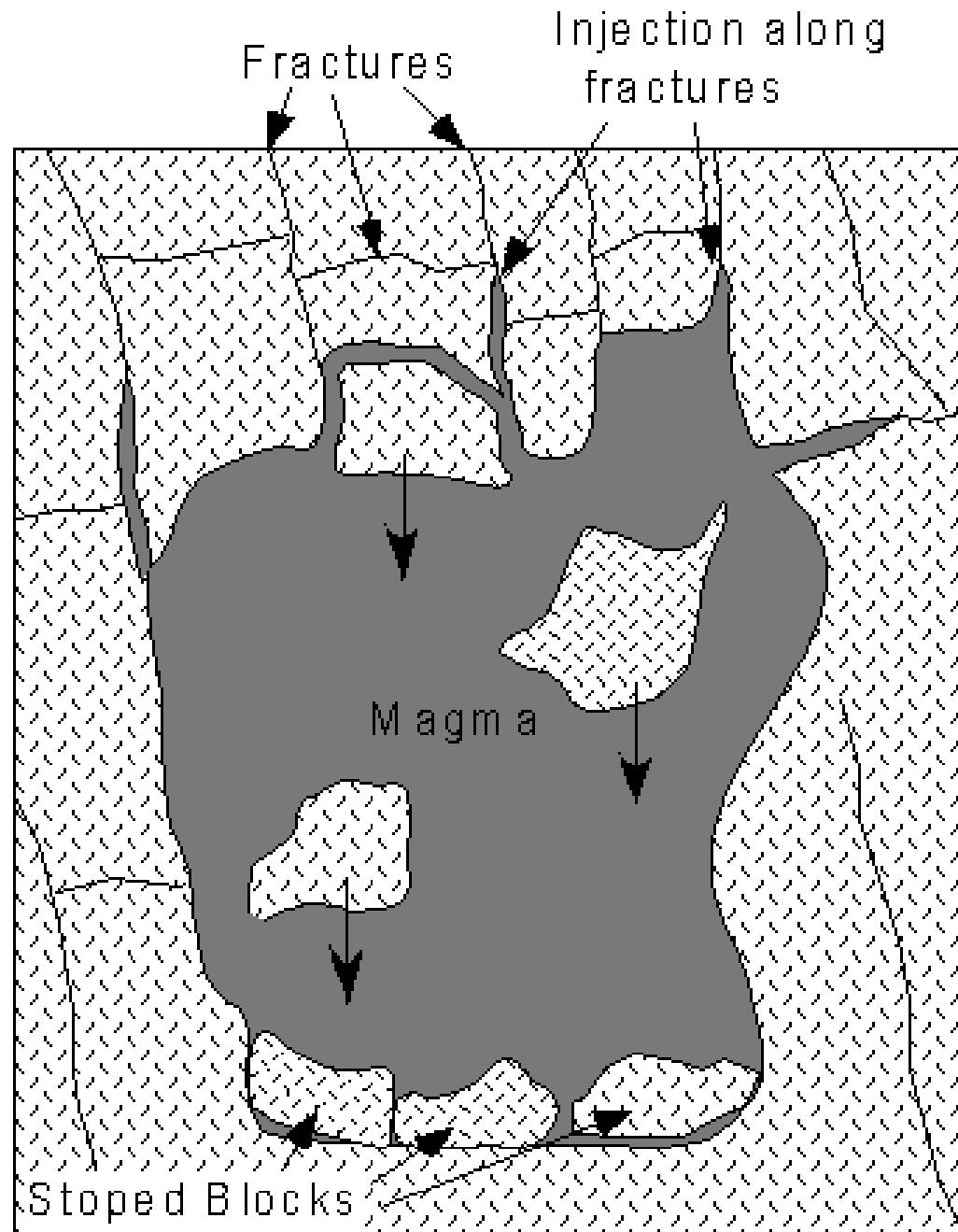
C. Extensive uplift and erosion exposes batholith

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Western US batholith exposure



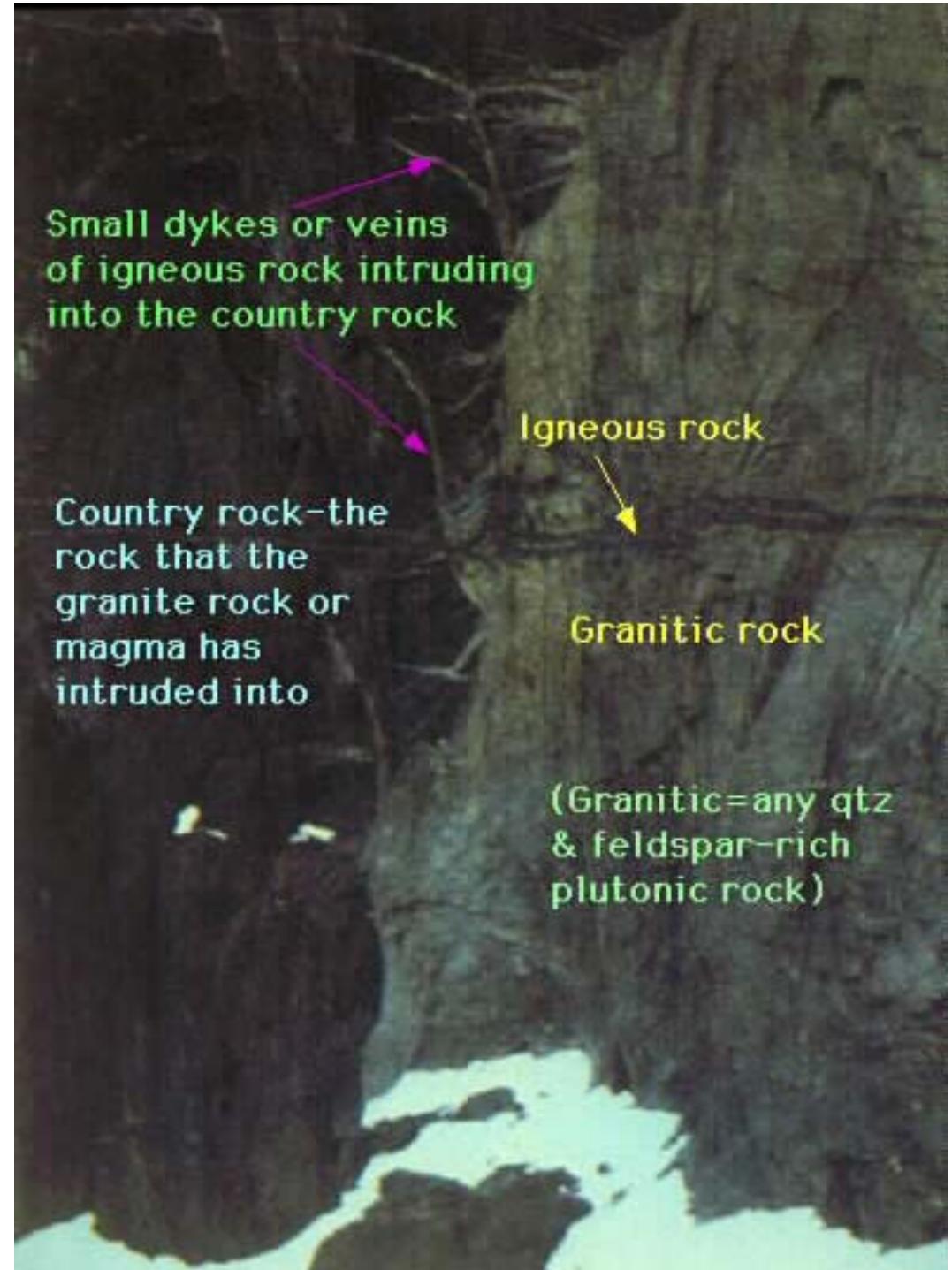




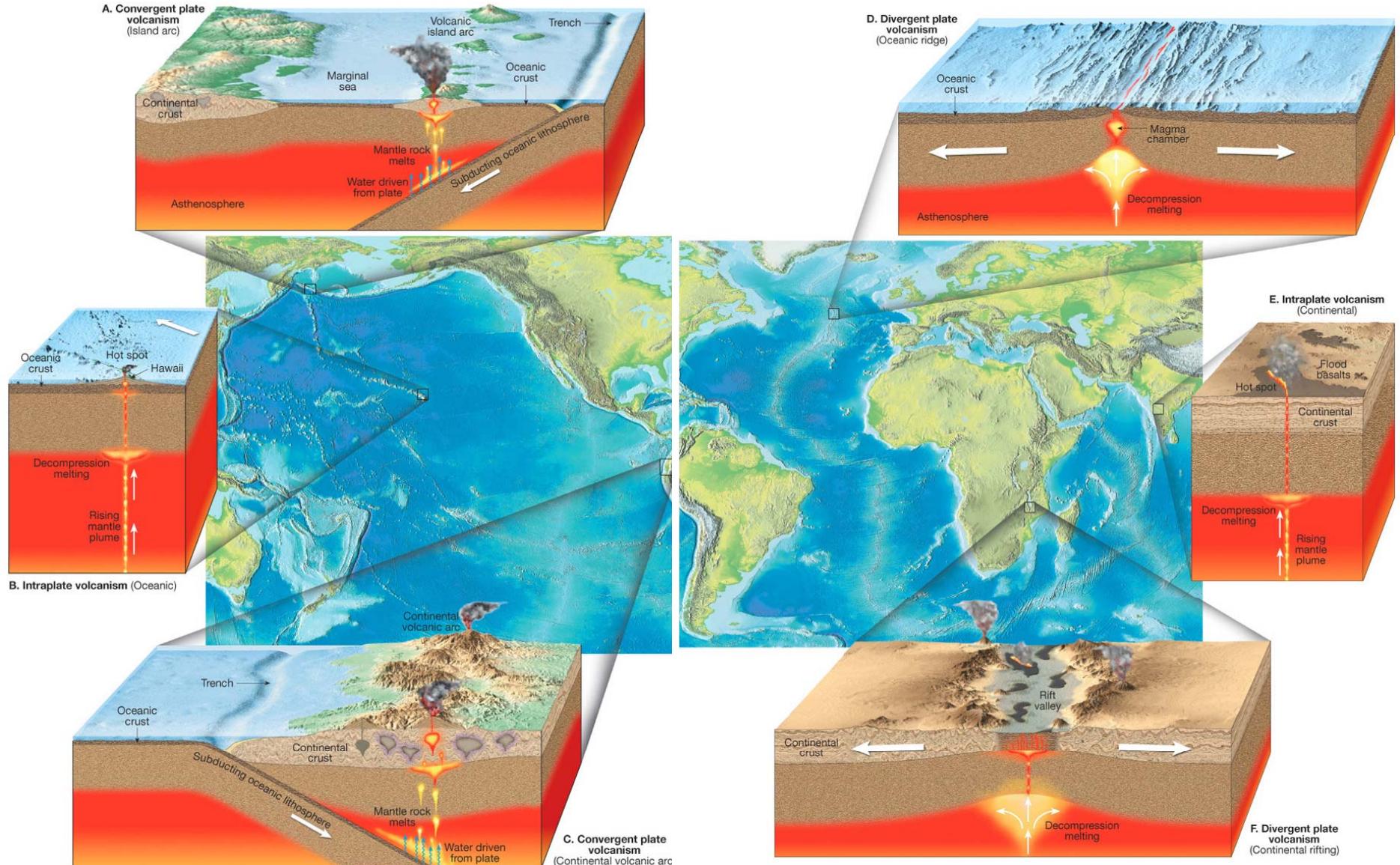


<http://www.es.ucsc.edu/~es10/classnotes/images/drawn.html>

Contact of Patagonia Pluton

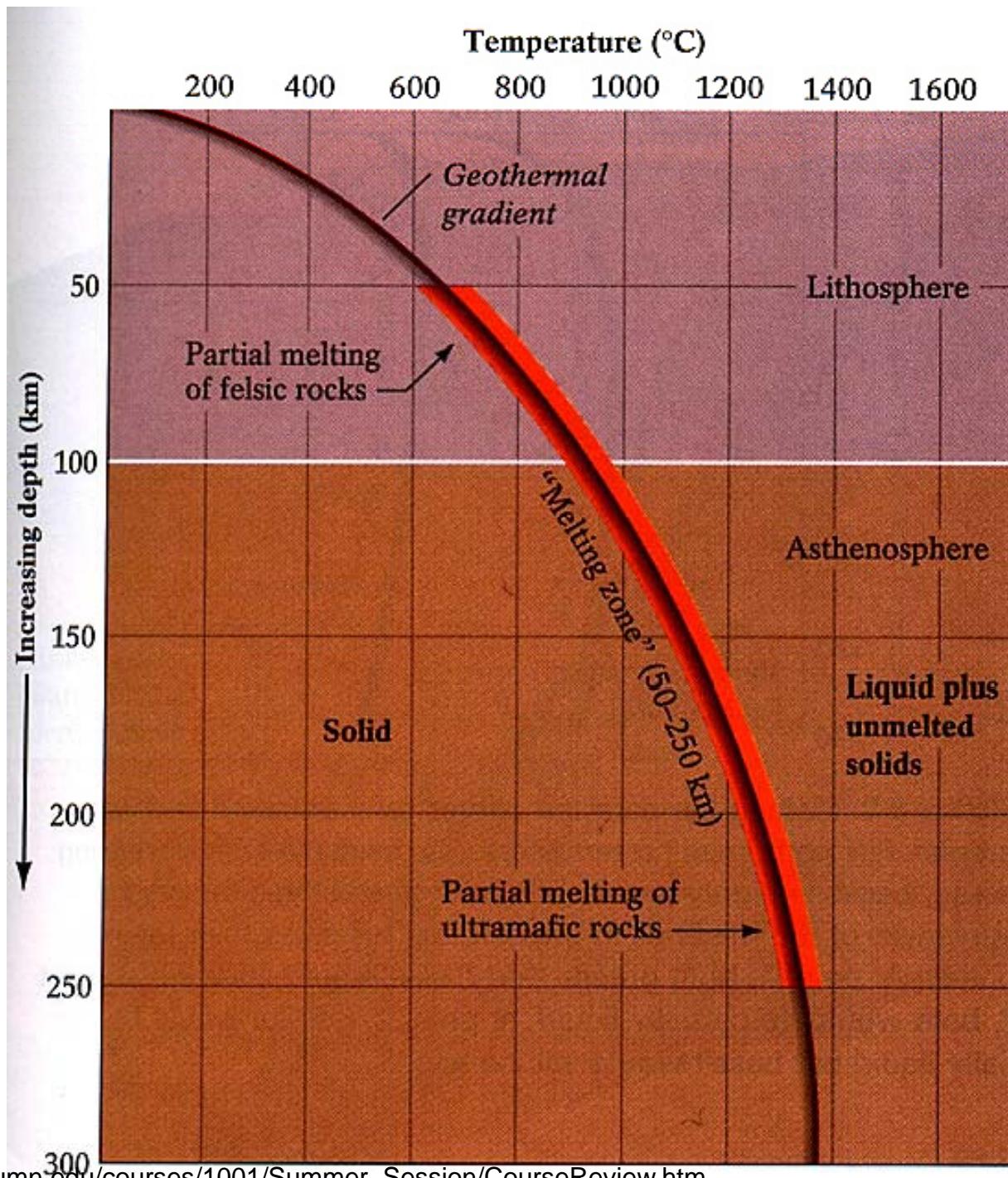


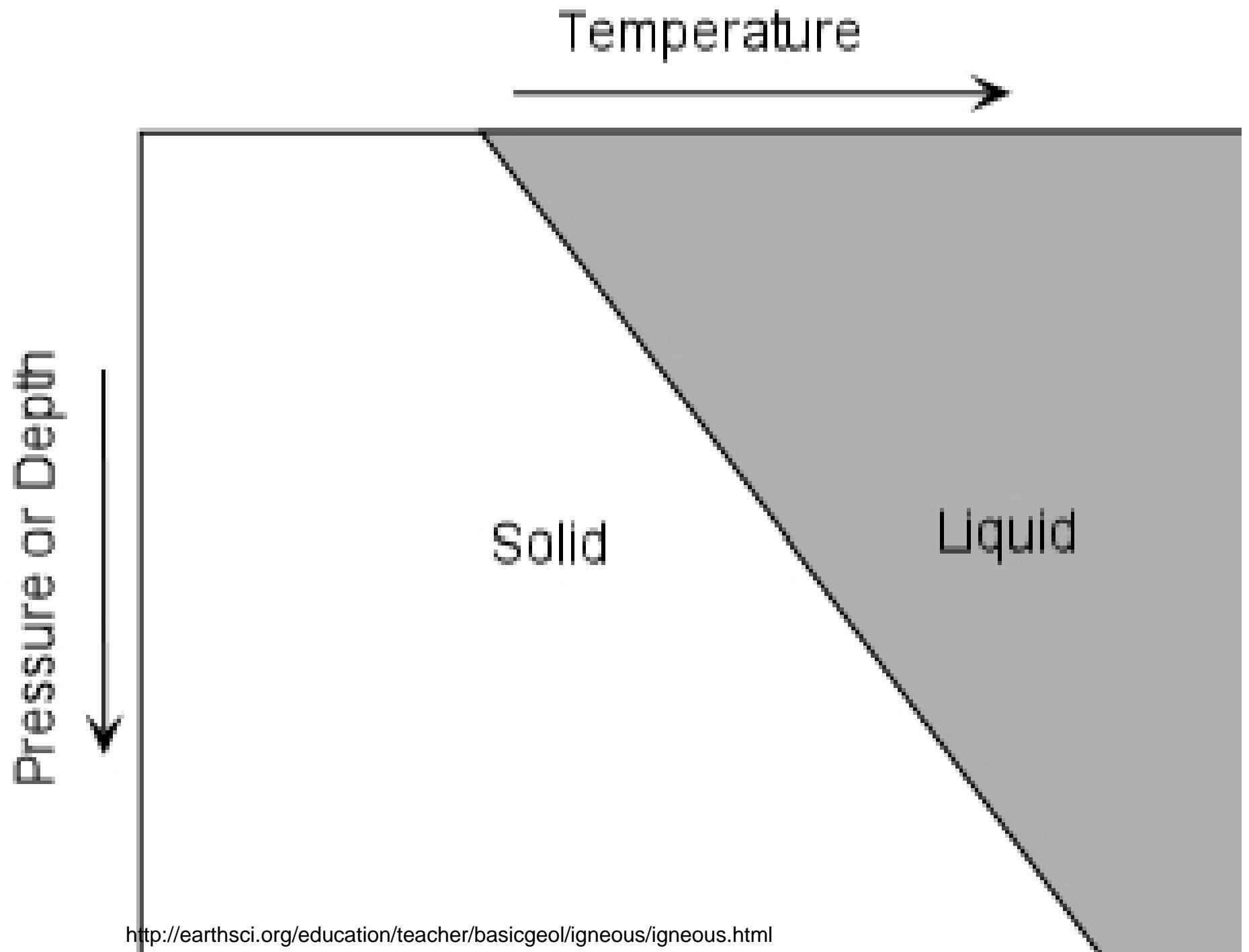
Magma environments

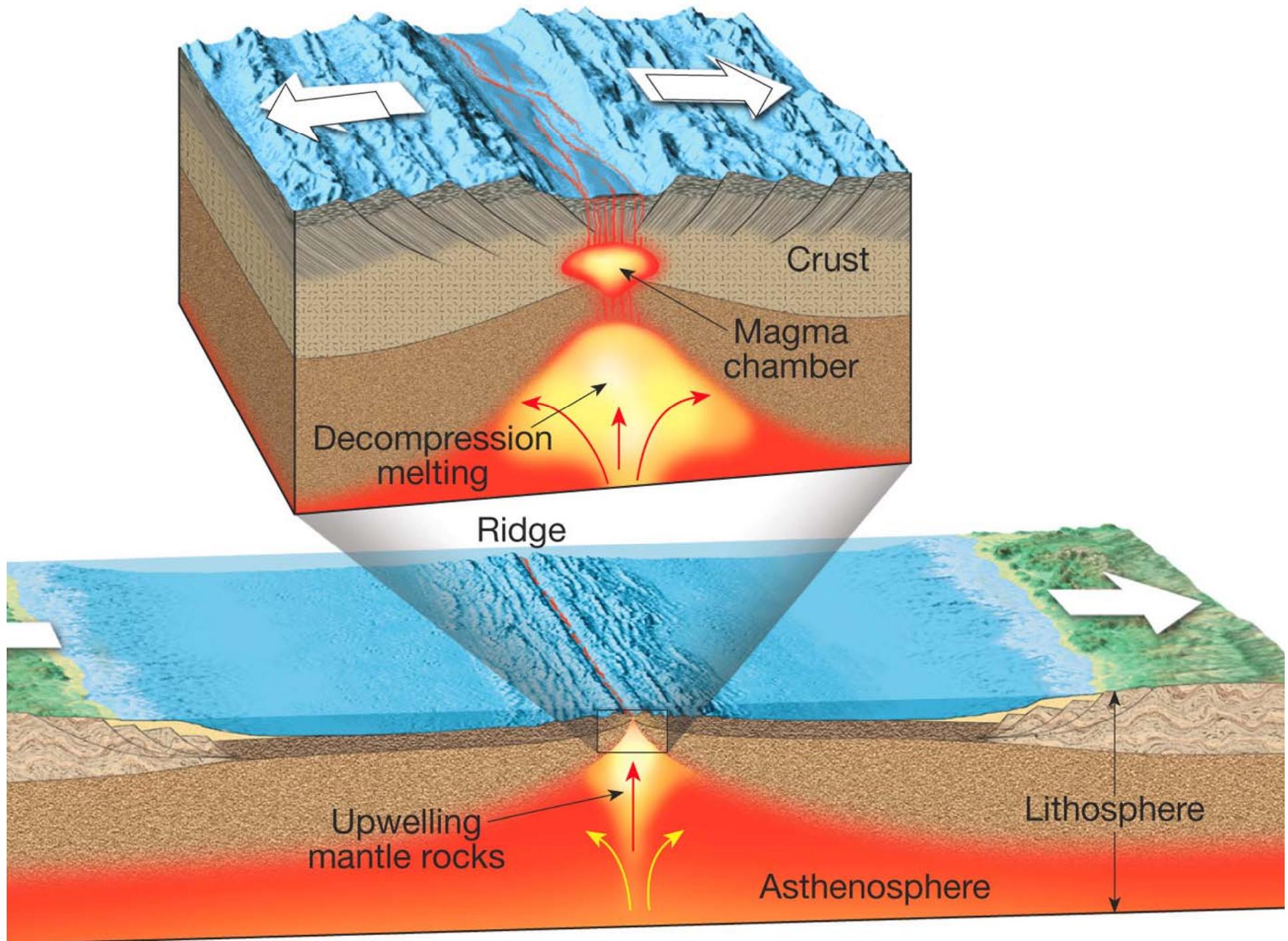


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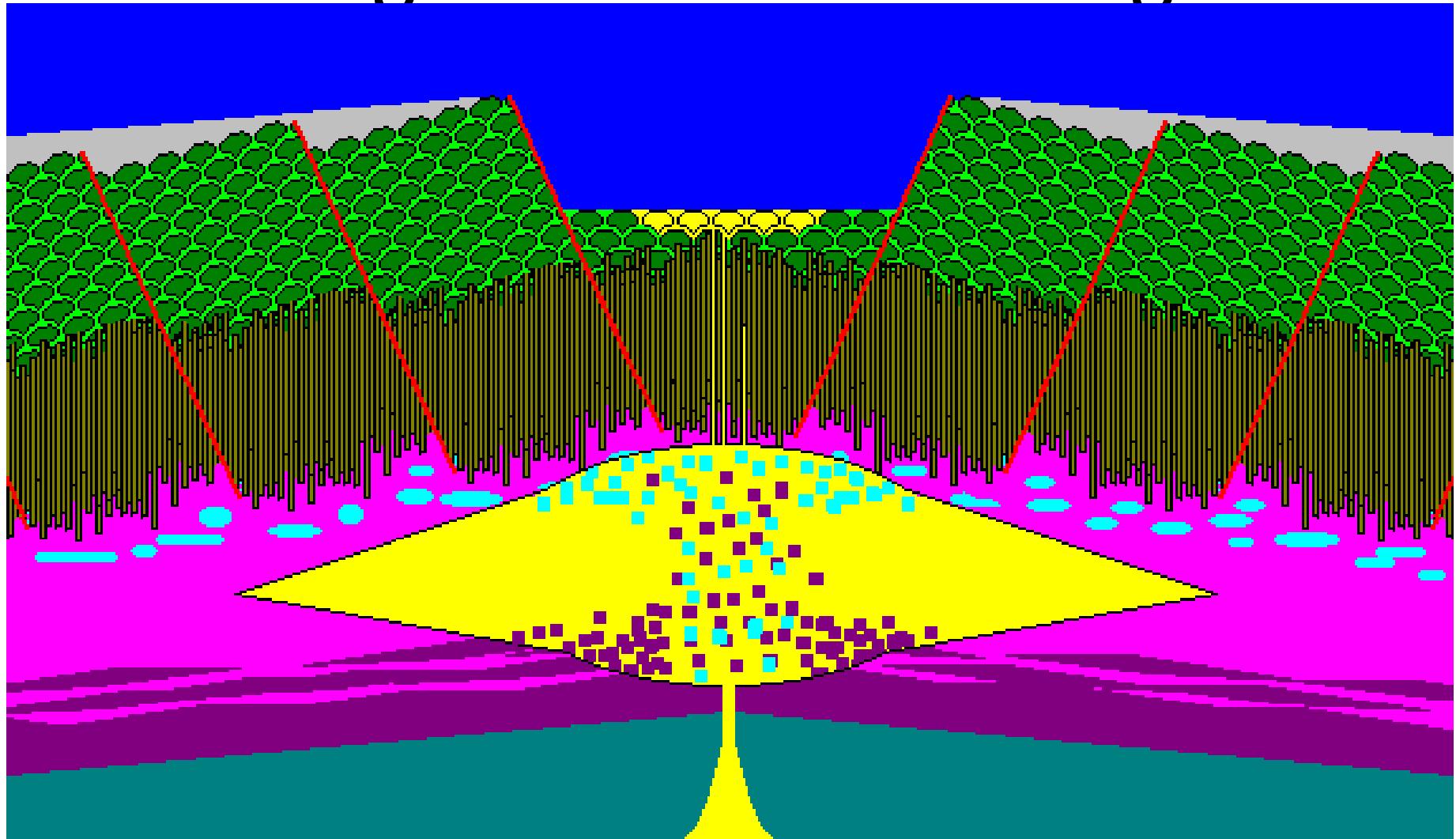
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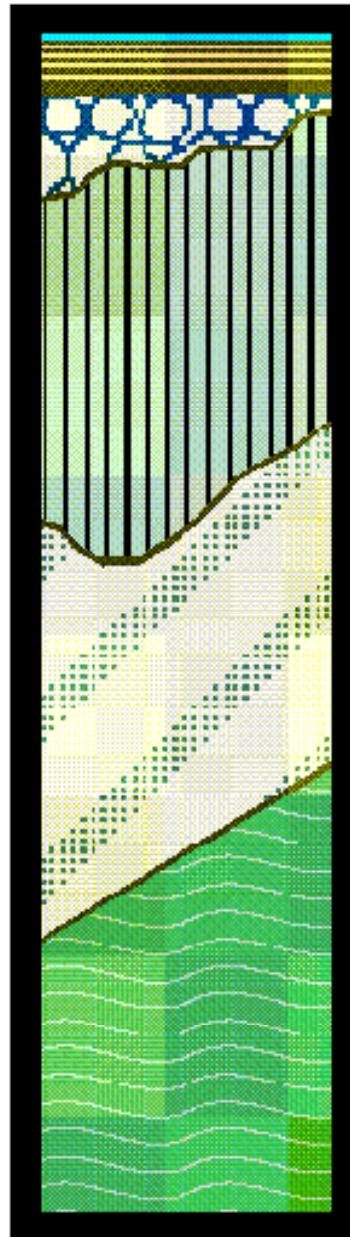




Magma at oceanic ridge



Oceanic ridge section



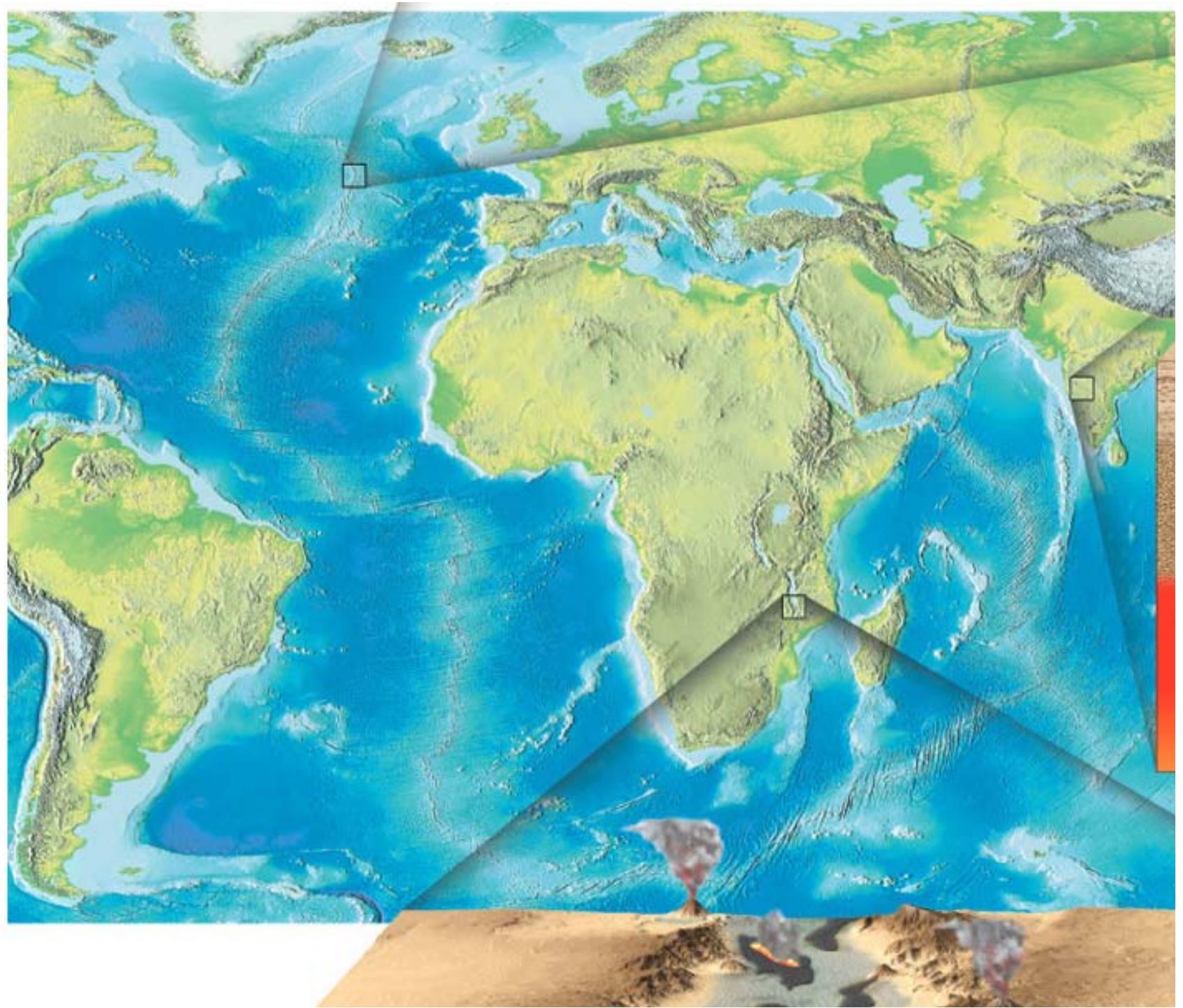
Marine Sediments
Pillow Basalt

Sheeted Dikes
← **You Are Here**

Gabbro

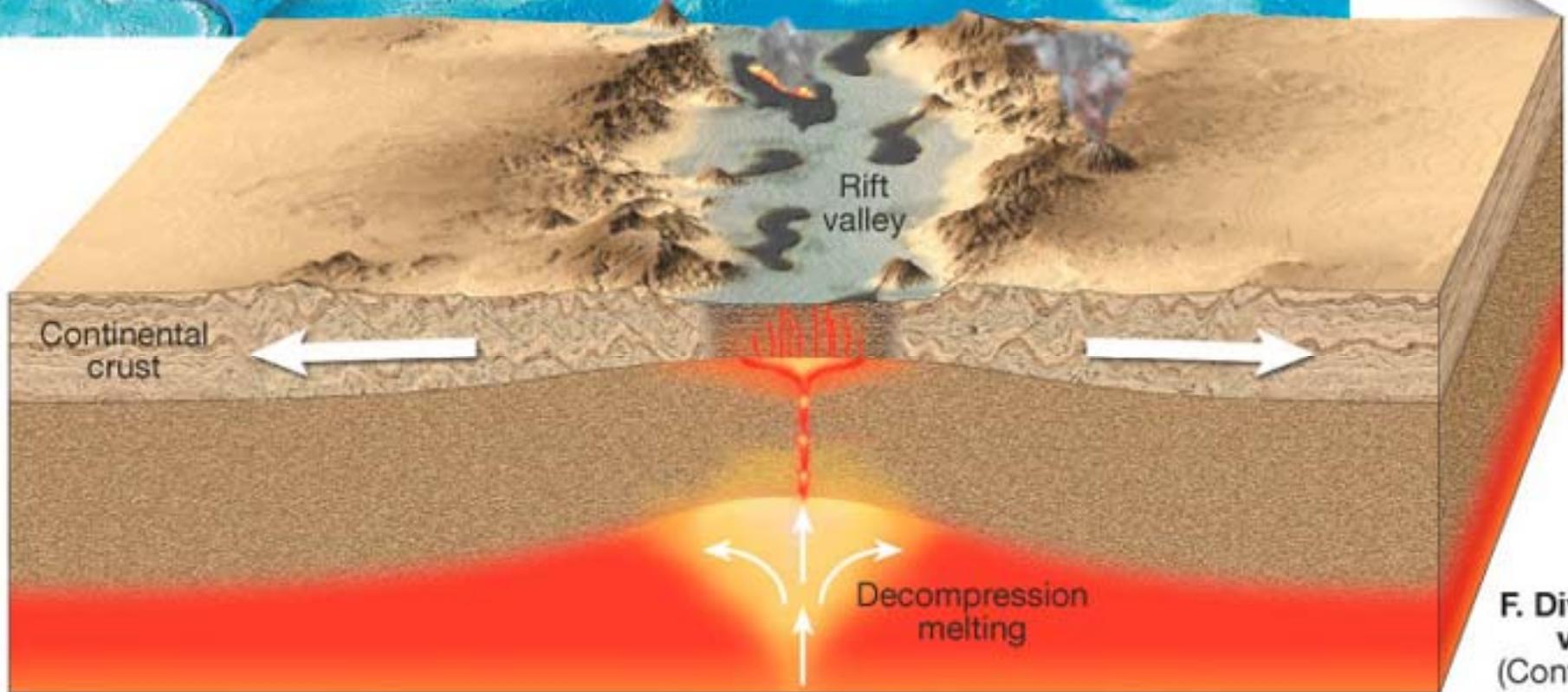
Peridotite

Ophiolite Sequence





Decompression melting



F. Div
vc
(Conti

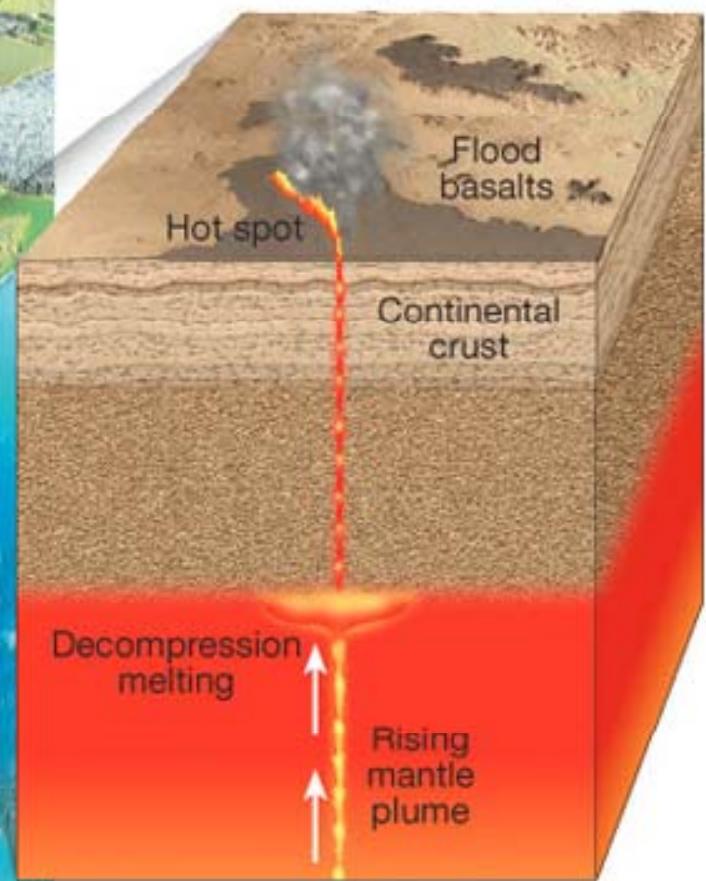
<http://www.mortbay.com/images/holidays/1998/Iceland/Iceland05.html>

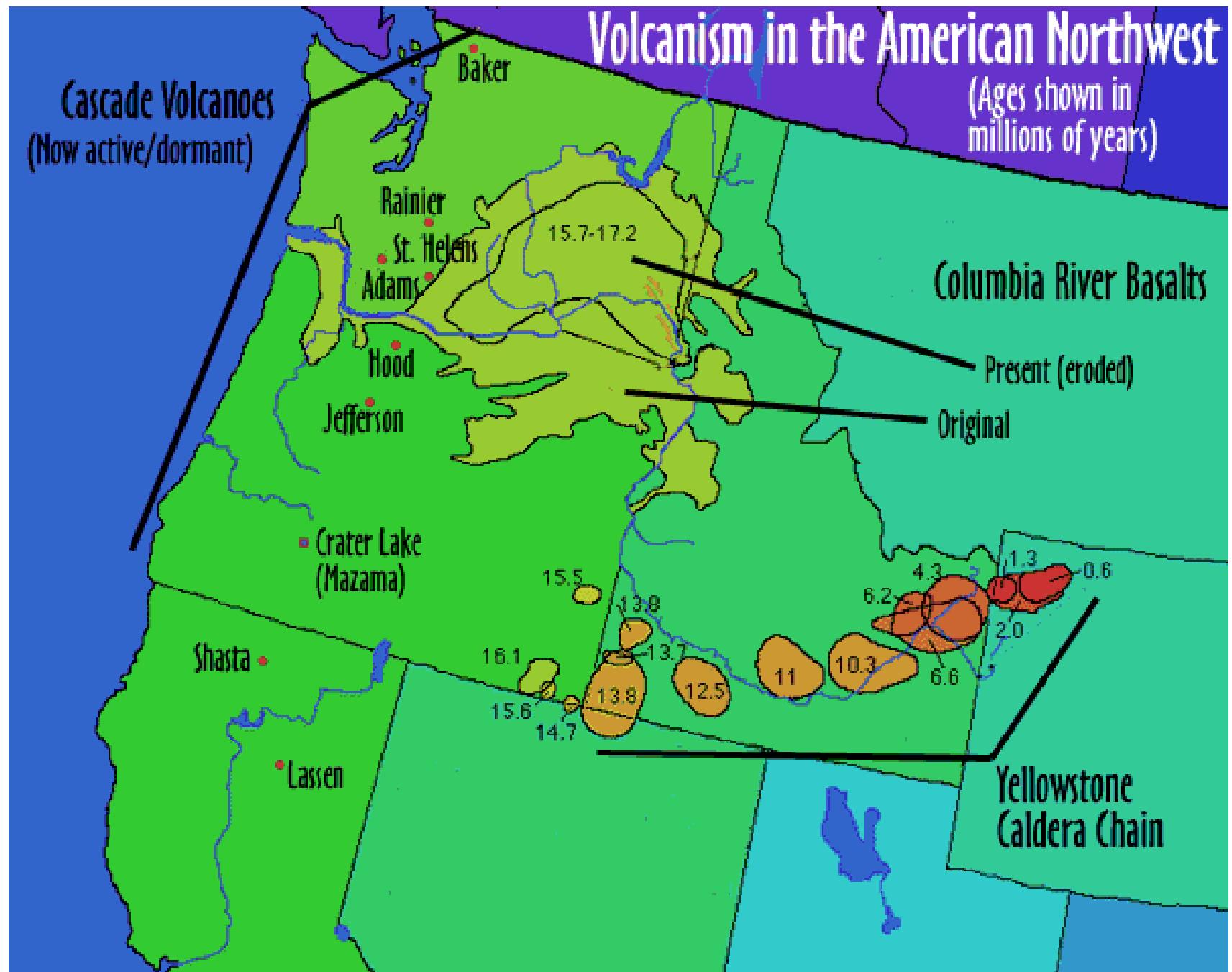


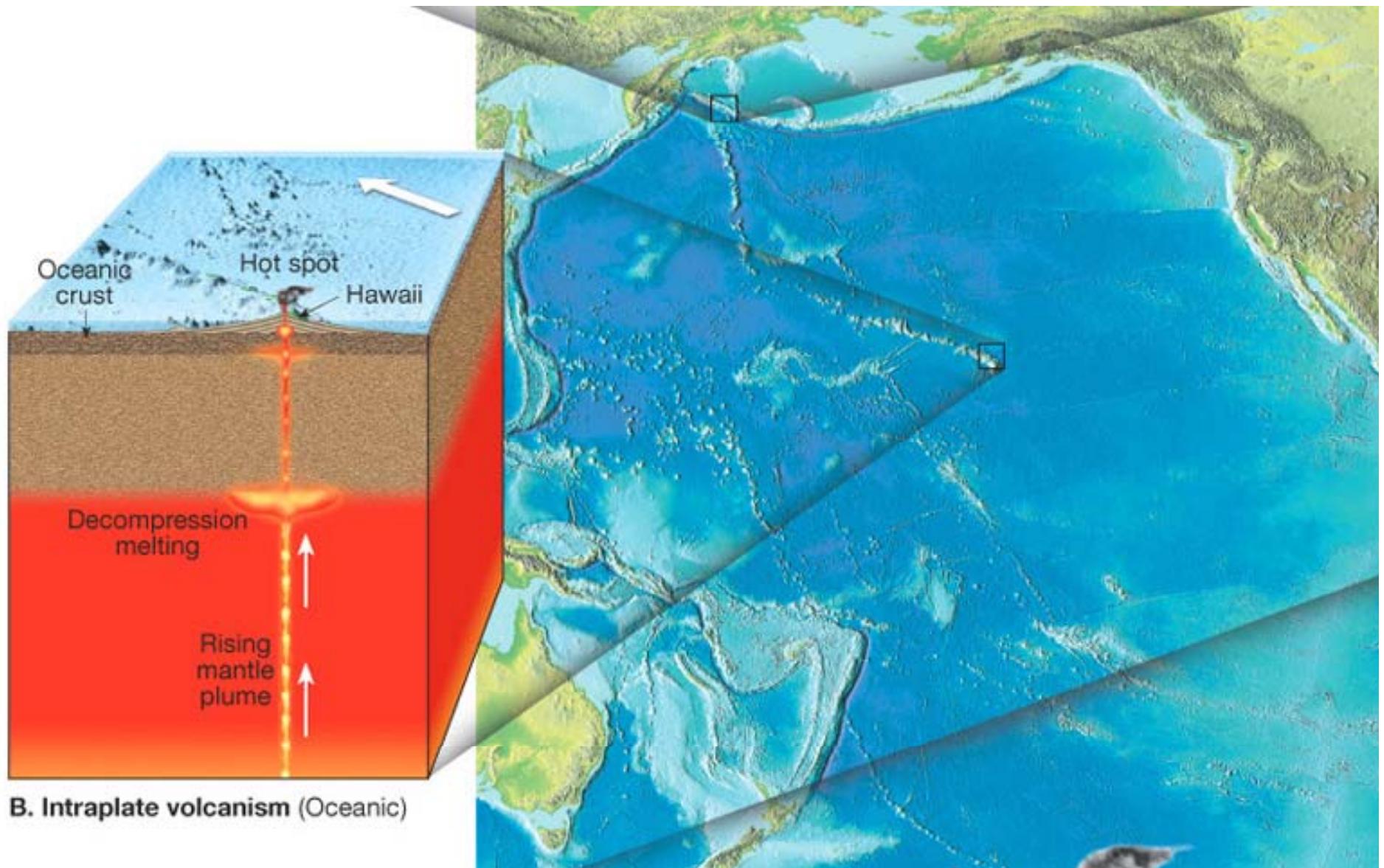
Iceland volcanic rift



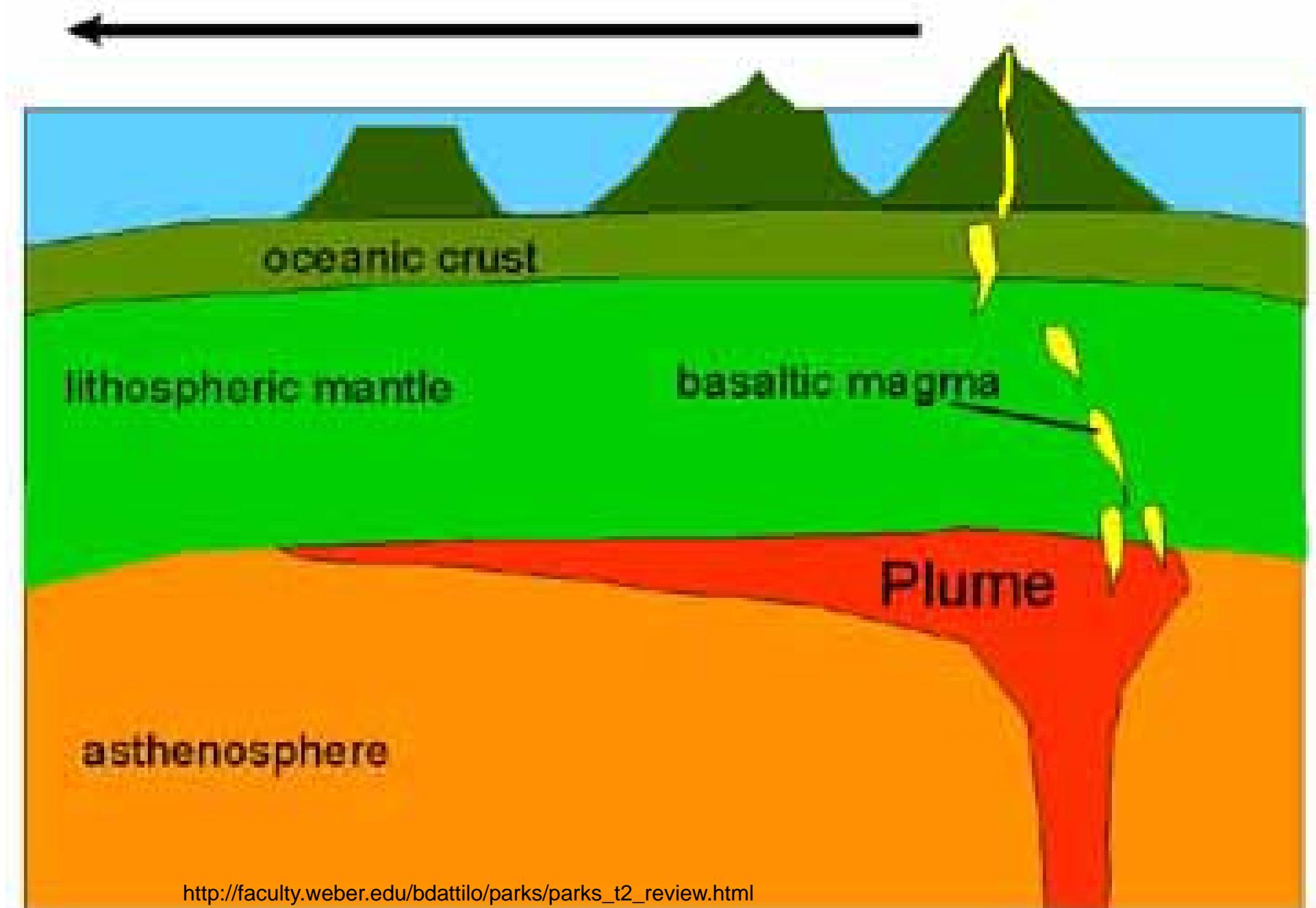
E. Intraplate volcanism
(Continental)



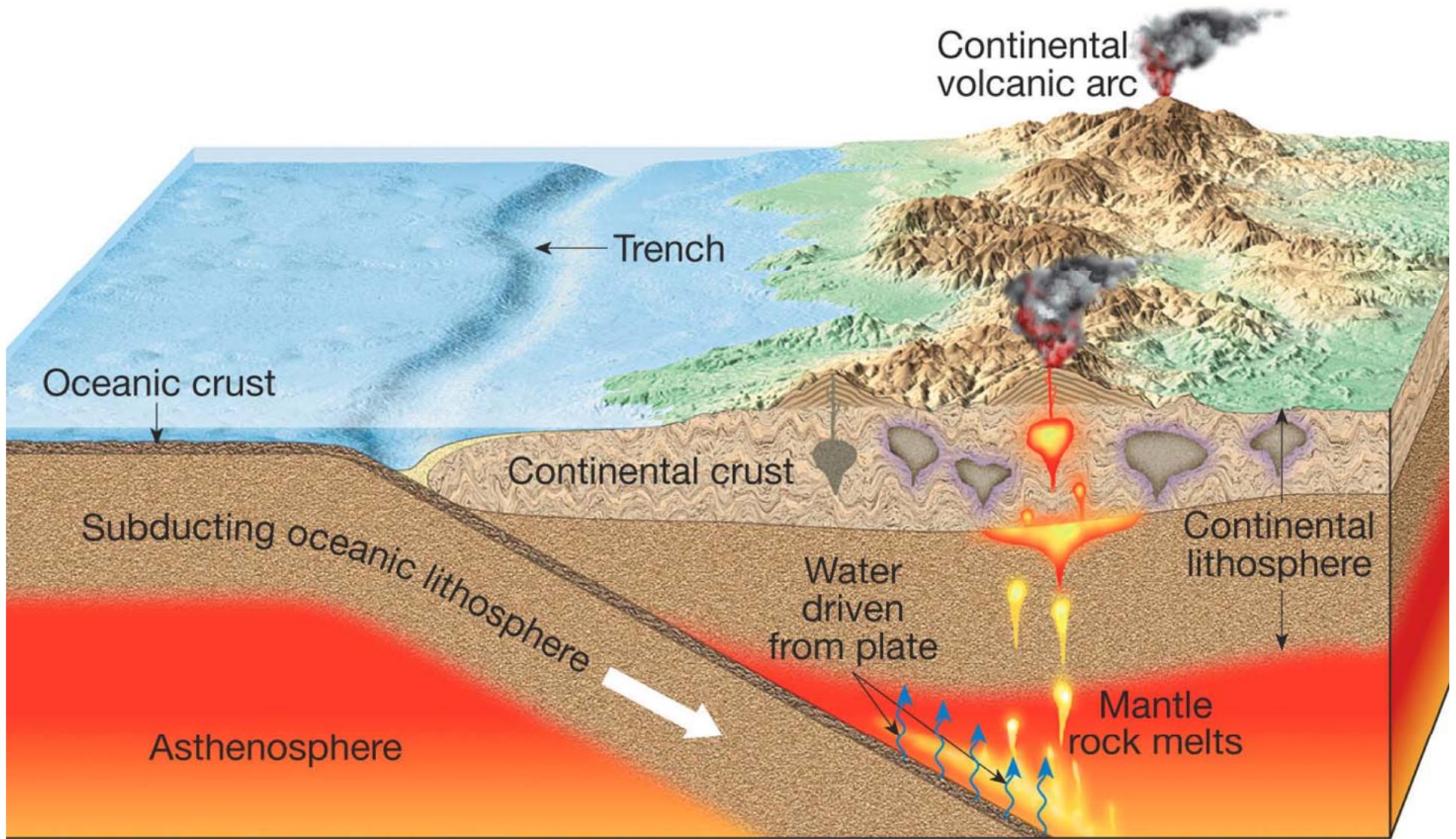




Direction of Plate Motion



Water driven from subducting slab



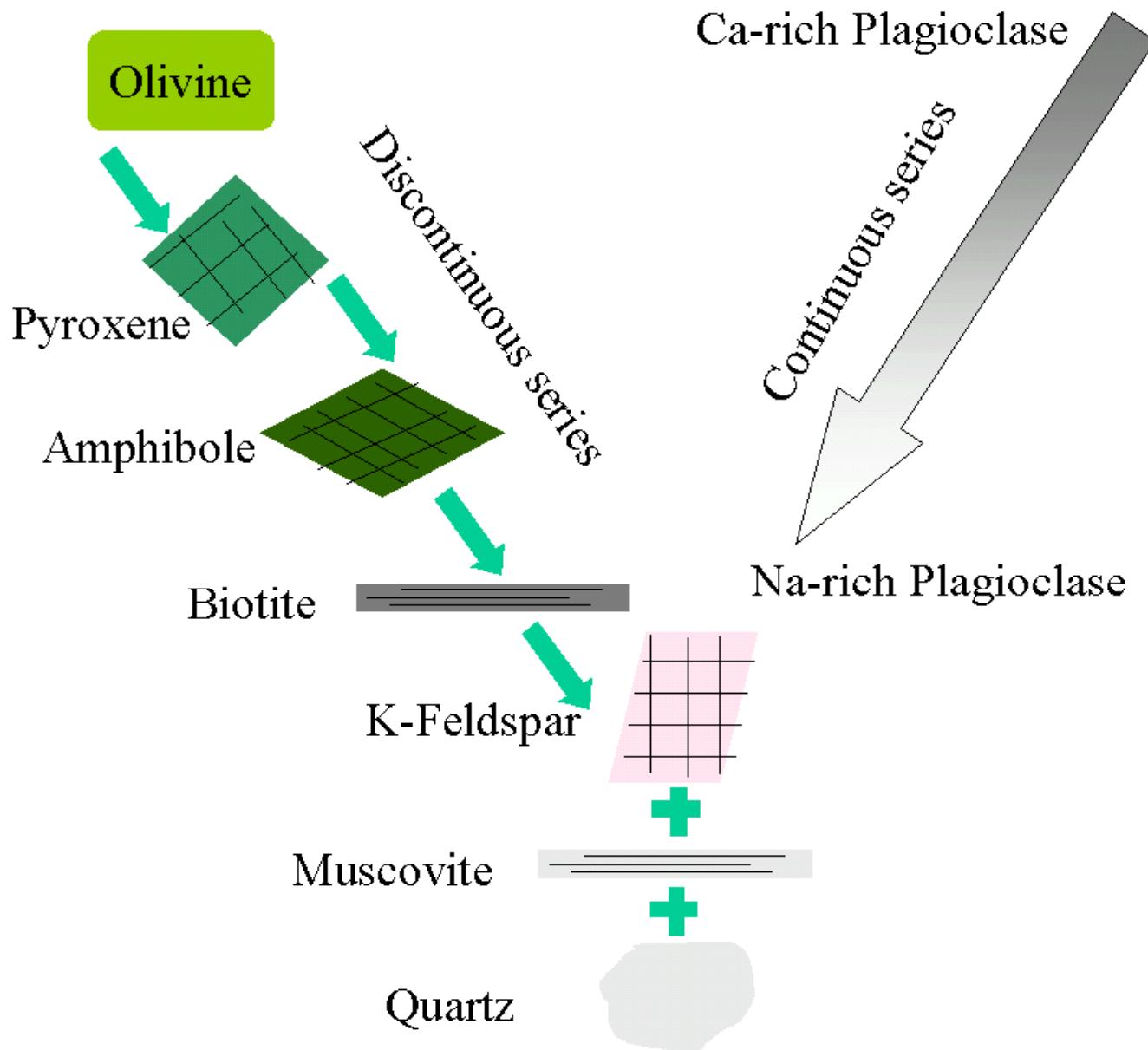
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Temp

Hi T,
early
cryst.

Lo T,
late
cryst.

Bowen's Reaction Series



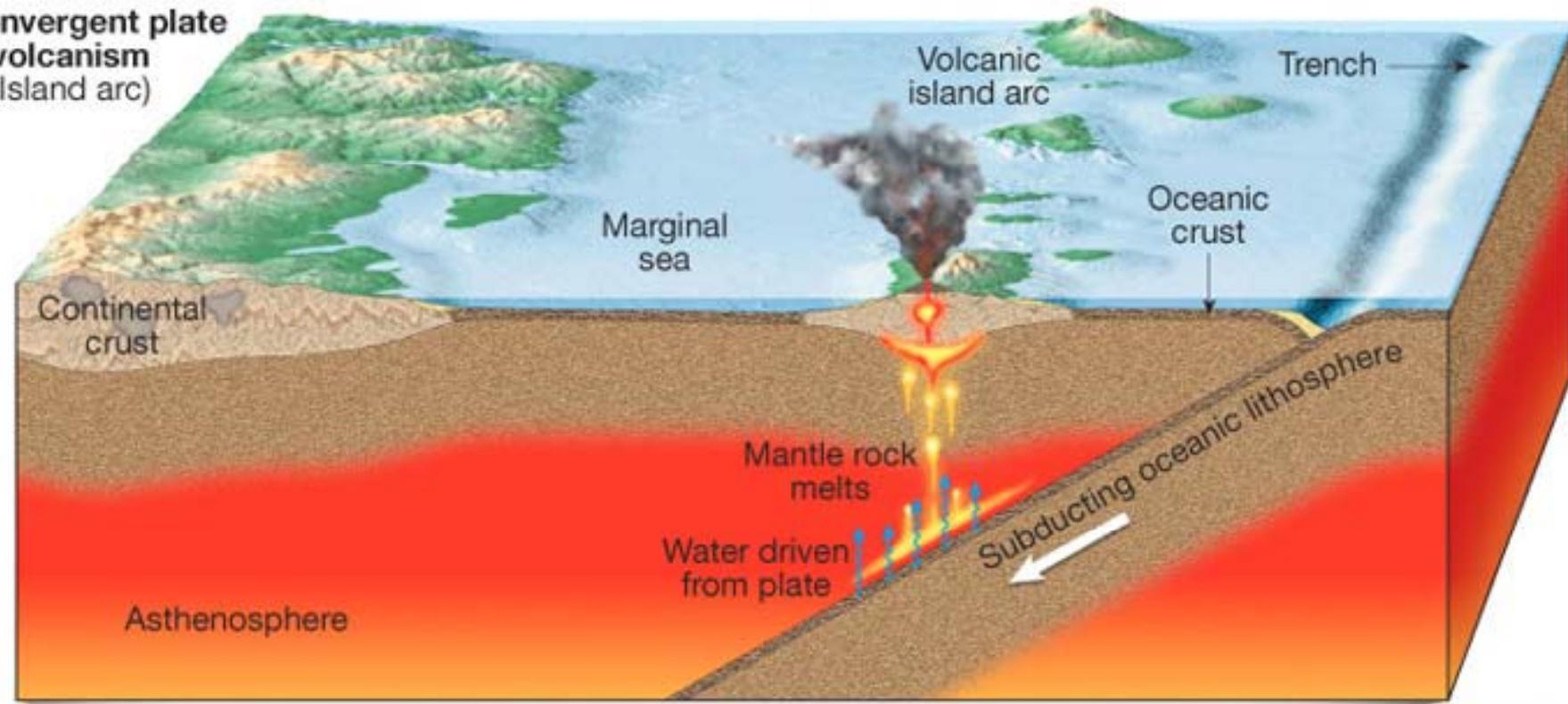
Igneous
Rock types
Ultramafic
Basaltic
Andesitic
Granitic

1.—melting increases volume



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Invergent plate
volcanism
(Island arc)





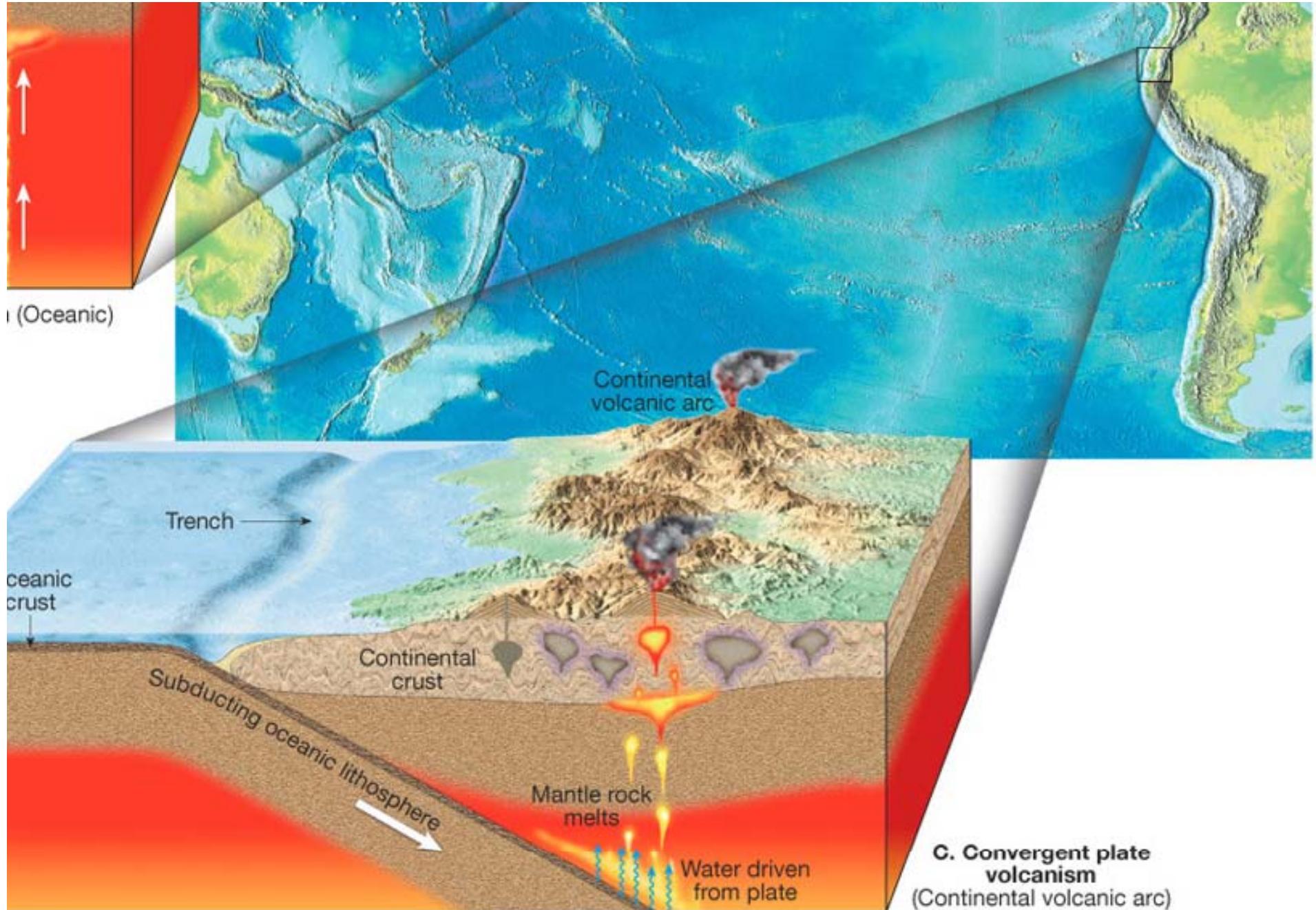
<http://home.earthlink.net/~patron9/> with permission of author tom bigley

<http://www.nationmaster.com/encyclopedia/Image:Aleutians-aerial.jpg>



Taken on the [STS-56 shuttle](#) mission, in April [1993](#). Image number: STS056-071-031

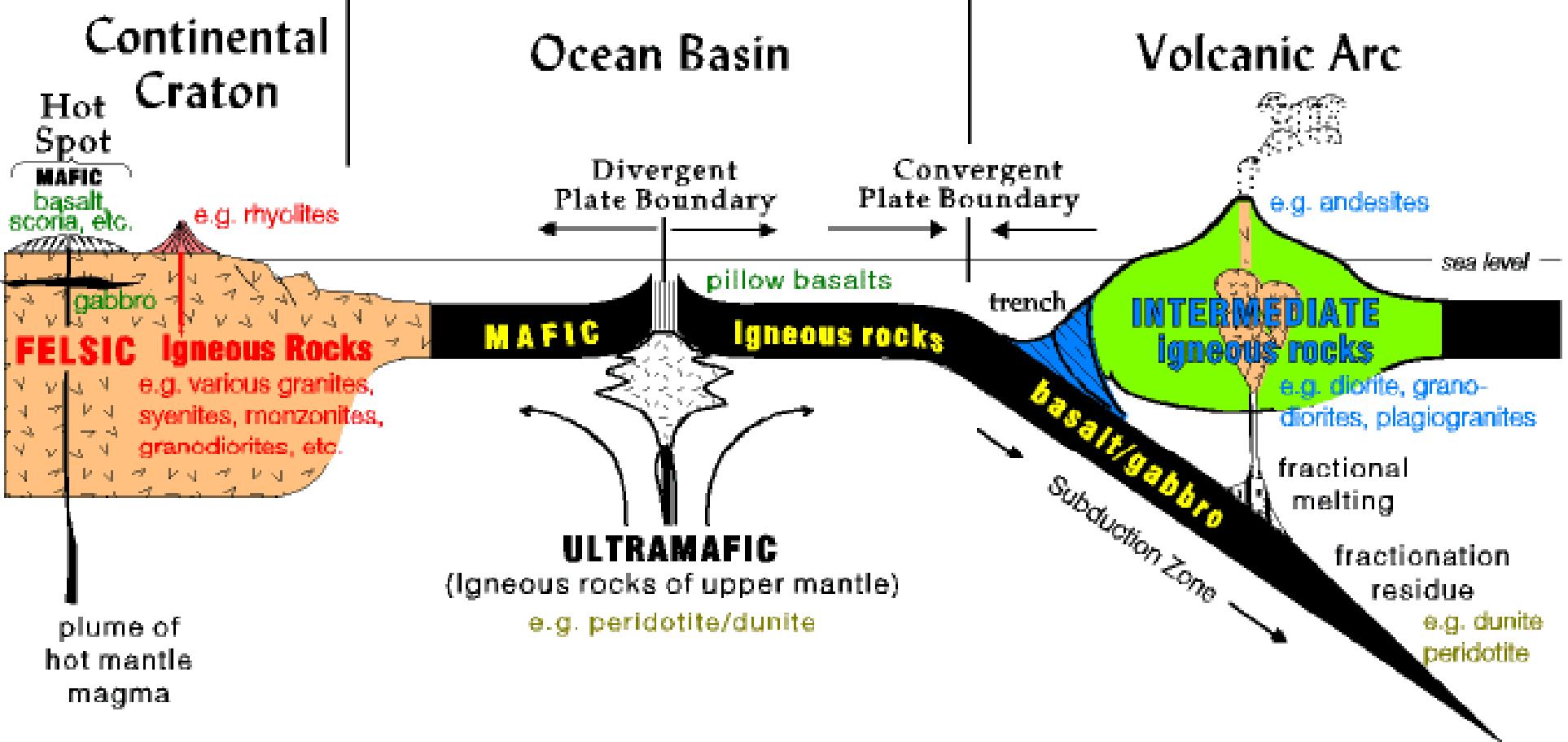
<http://en.wikipedia.org/wiki/Image:Aleutians-space.jpg>



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<http://worldwind.arc.nasa.gov/screenshots-bm.html>



Mineral Resources

- Ore:
 - Mineral or rock from which metal is extracted
 - Anything that can be mined at a profit
- Industrial mineral:
 - geological materials which are mined for their commercial value, which are not fuel and are not sources of metals

Ore Deposits

- Many metallic elements don't fit into common silicate crystal structures
- Remain in solutions left by cooling magma
- Can permeate surrounding rocks or fill cracks in surrounding rocks

Disseminated Ore Deposits

- Solutions permeate surrounding rocks
- Precious metals: mostly gold
- Base metals: copper, lead, zinc

El Peñón - Q3 Production

	Q3 07	2007 Forecast
Mill throughput	2,863 tpd	2,700 - 2,750 tpd
Avg. gold grade	7.6 g/t	7.5 - 7.8 g/t
Gold recovery	94%	94%
Gold produced	58,928 oz	230K - 235Koz
Avg. silver grade	262 g/t	280 - 285 g/t
Silver recovery	92%	92%
Silver produced	2.2 M oz	8.3 - 8.8 M oz

\$/tonne mined \$52 - \$55

\$/tonne processed \$22 - \$23

\$/tonne admin \$8 - \$9



- **Disseminated gold deposit**

- http://nevada-outback-gems.com/basic_prospecting/gold_geology.htm



Copper mine
in Arizona

<http://www.mining-technology.com/projects/bingham/bingham2.html>



- Bingham Canyon Copper Mine: largest manmade excavation on Earth



- Copper-cobalt deposit in Zambia

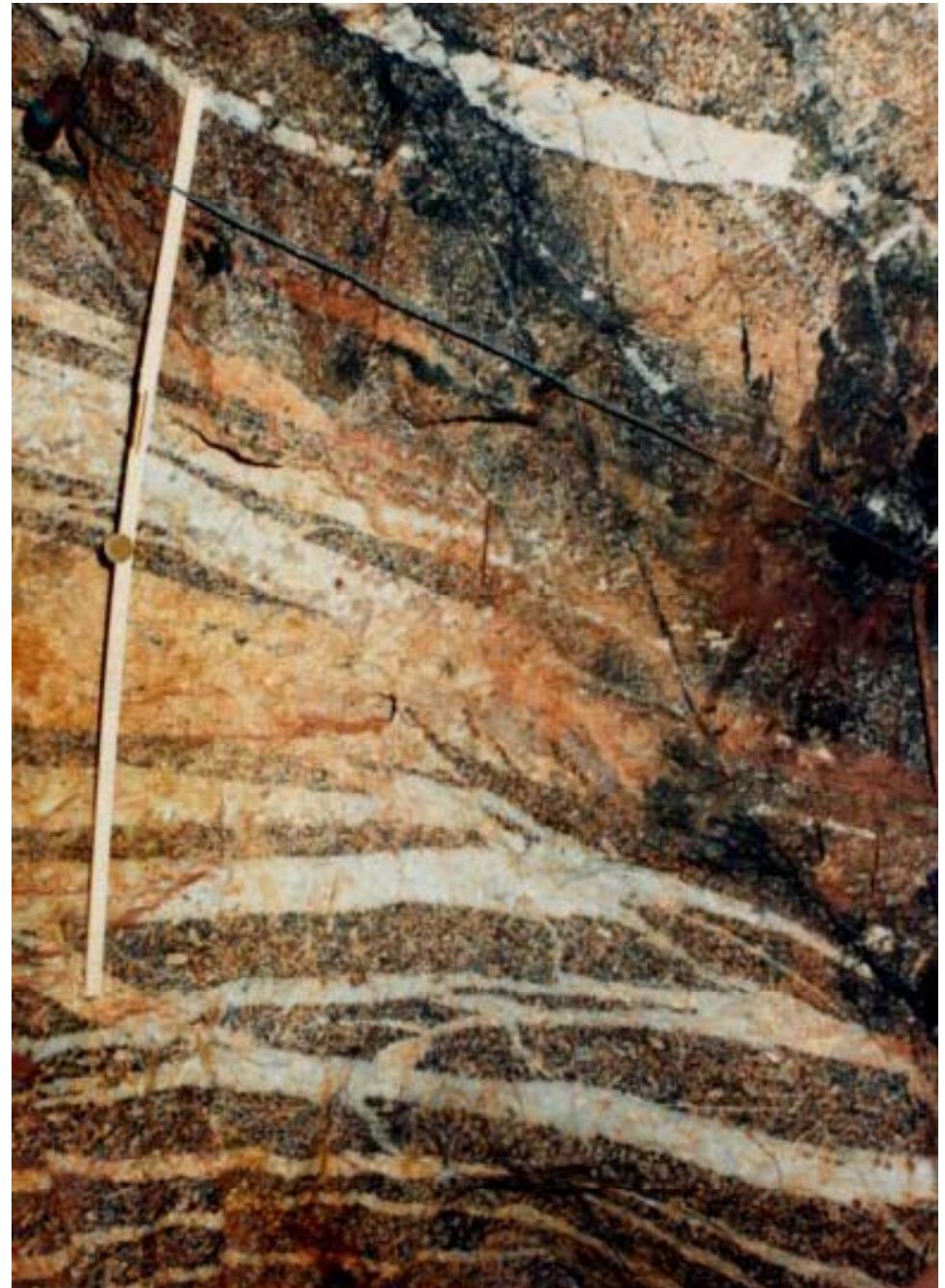
- http://www.datametallogenica.com/pages/minidisc/html/nkana_files/nkana-fieldmine/page.html

Vein Ore Deposits

- Fluid fills cracks in surrounding rocks
- Mineral deposits are often visible to the naked eye
- Hydrothermal deposits

Hydrothermal veins

- Commonly have quartz and/or calcite
- Sometimes other minerals deposited
- The ‘mother lode’ gold deposits were of this type



- <http://myweb.tiscali.co.uk/geologyofcornwall/Mineralisation.htm>



- Sulfide vein deposit
 - <http://www.zambia-mining.com/explorationright.html>



Vein deposits

- Copper vein deposit
 - http://gsc.nrcan.gc.ca/mindep/photolib/gold/nugget/index_e.php

Placer Ore Deposits

- Concentrated by weathering and transportation
- Streams, beaches

Placer Gold



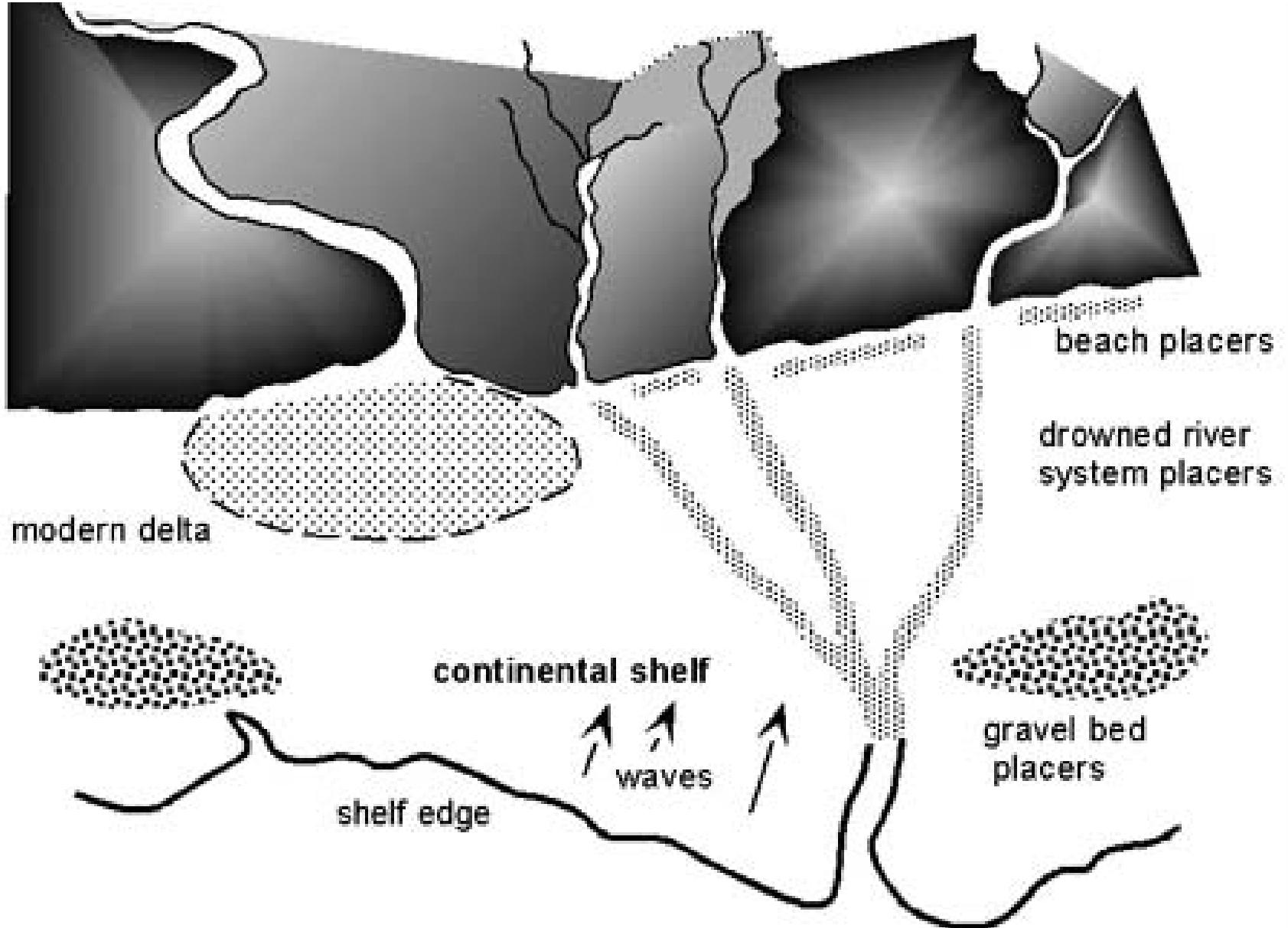
- Panning and sluice box methods

http://nevada-outback-gems.com/basic_prospecting/Panning.htm
http://nevada-outback-gems.com/basic_prospecting/sllicing.htm



- Historic and modern commercial placer mining





- gold, platinum, tin, titanium, and rare earth metals

Marine placer deposits

“Industrial” Minerals

- Usually not metals
- Limestone for cement
- Sand and gravel for construction
- Chemicals
 - Fertilizer
 - Flux
 - Salt
- Clay for bricks and ceramics



- Cement factory: processes limestone
 - <http://www.abbasllcgroup.com/cement>



- <http://www.weirimc.com/industries.htm>
- Sand and gravel operation



- Potassium chloride (sylvite) for fertilizer

Detroit salt mine



- Note pillar and room excavation

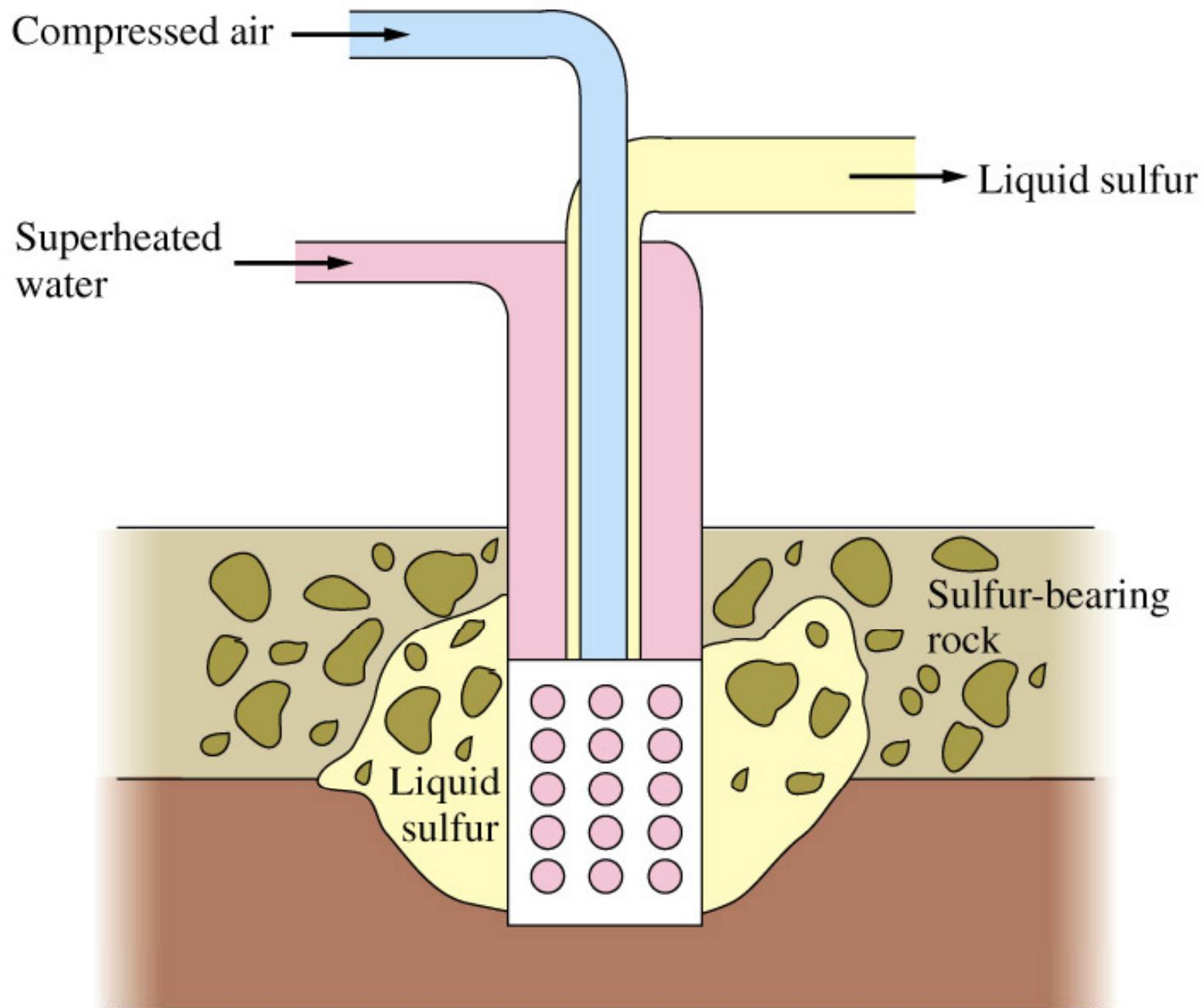
<http://www.detroitsalt.com/home.htm>



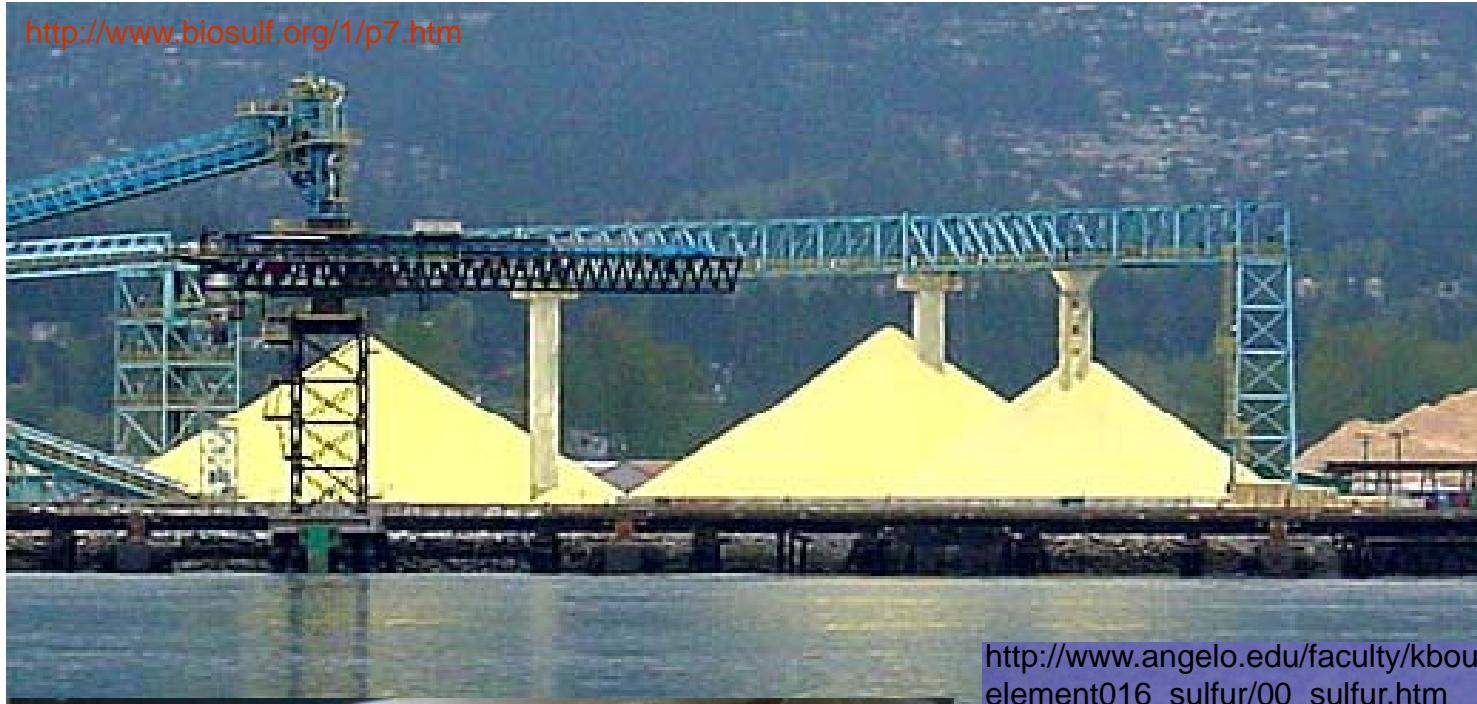
<http://Muke.szkudlarek.pl/blog/2007/08/12/best-places-to-see-in-poland/>



- Sri Lanka



<http://www.biosulf.org/1/p7.htm>



<http://library.thinkquest.org/05aug/00461/sulfur.htm>

http://www.angelo.edu/faculty/kboudrea/molecule_gallery/element016_sulfur/00_sulfur.htm



http://www.onlineminerals.com/admin/my_documents/my_pictures/F1Z_Witkop.jpg



Fluorite



http://www.onlineminerals.com/admin/my_documents/my_pictures/CFE_fluorite_vein.JPG