MSc (second semester)

Elective Paper

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Large Volcano on Earth

Why important to study volcanoes

- Weathering and physical disintegration of volcanic materials form some of the most fertile soils on Earth, so critical for growing abundant food
- Internal heat associated with young volcanic systems are harnessed to produce geothermal energy.
- Most of the important metals -such as copper, gold, silver, lead, and zinc--are associated with magmas found deep within the roots of extinct/ancient volcanoes.
- At present nearly 200 million people reside globally within about 30 km radius, and neraly 50 miilion people within 5 km radius of 1300 volcanoes.

Contd…

- Effects of volcanic eruptions have significant socio-economic impact. For example, in 2010 the eruption at Eyjafjallajokull Volcano led to the closure of Europe's airspace incurring financial loss of more than US$2.5 billion (Airports Council International, 2010)

- Total financial impact on global income in terms of Gross Domestic Product, GDP) amounts to US $4.7 billion approximately (Oxford Economics, 2013).

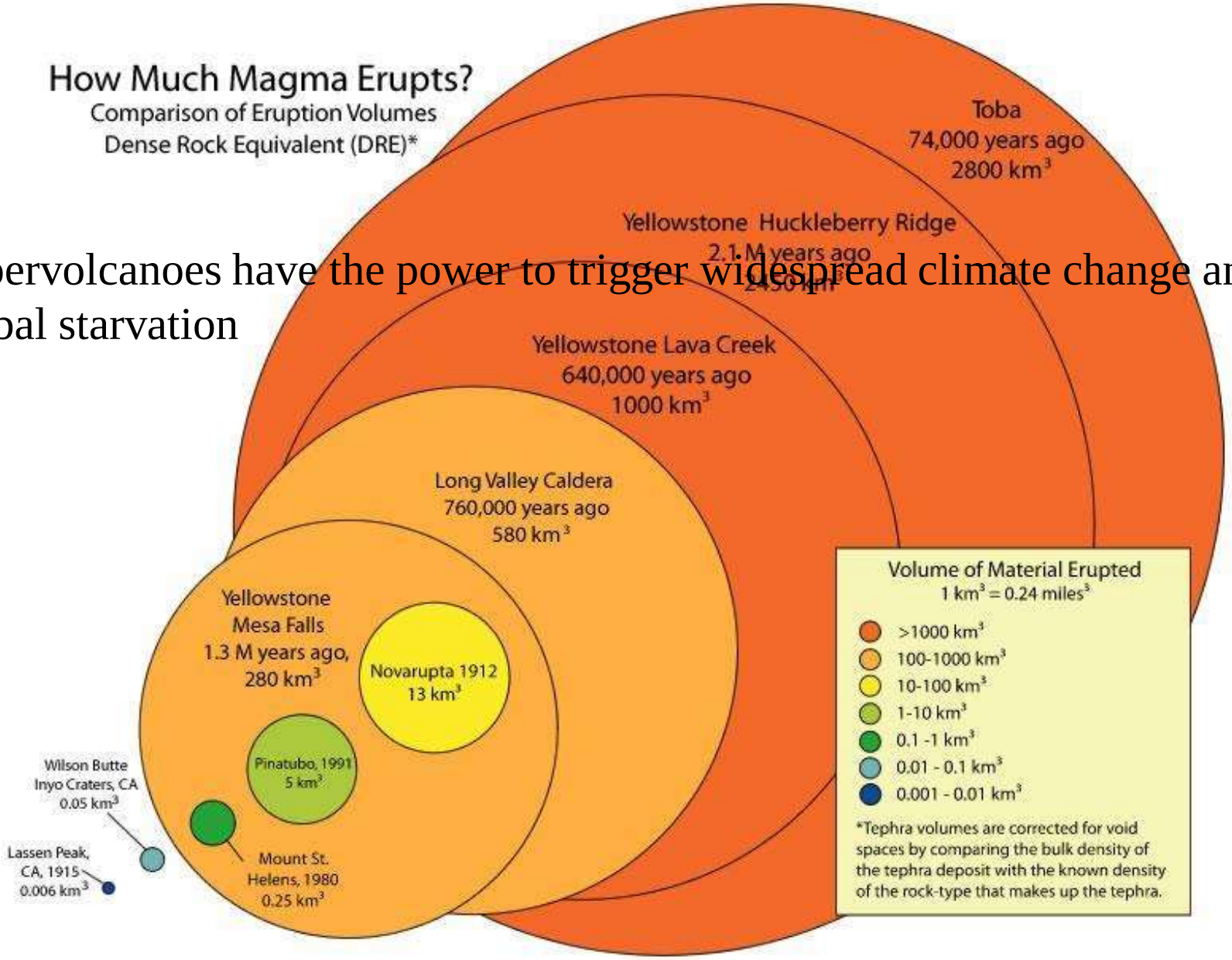
Scientists around the world are collaborating to monitor volcanic activity and better inform governments on preparing for the next major eruption

Large volcanoes

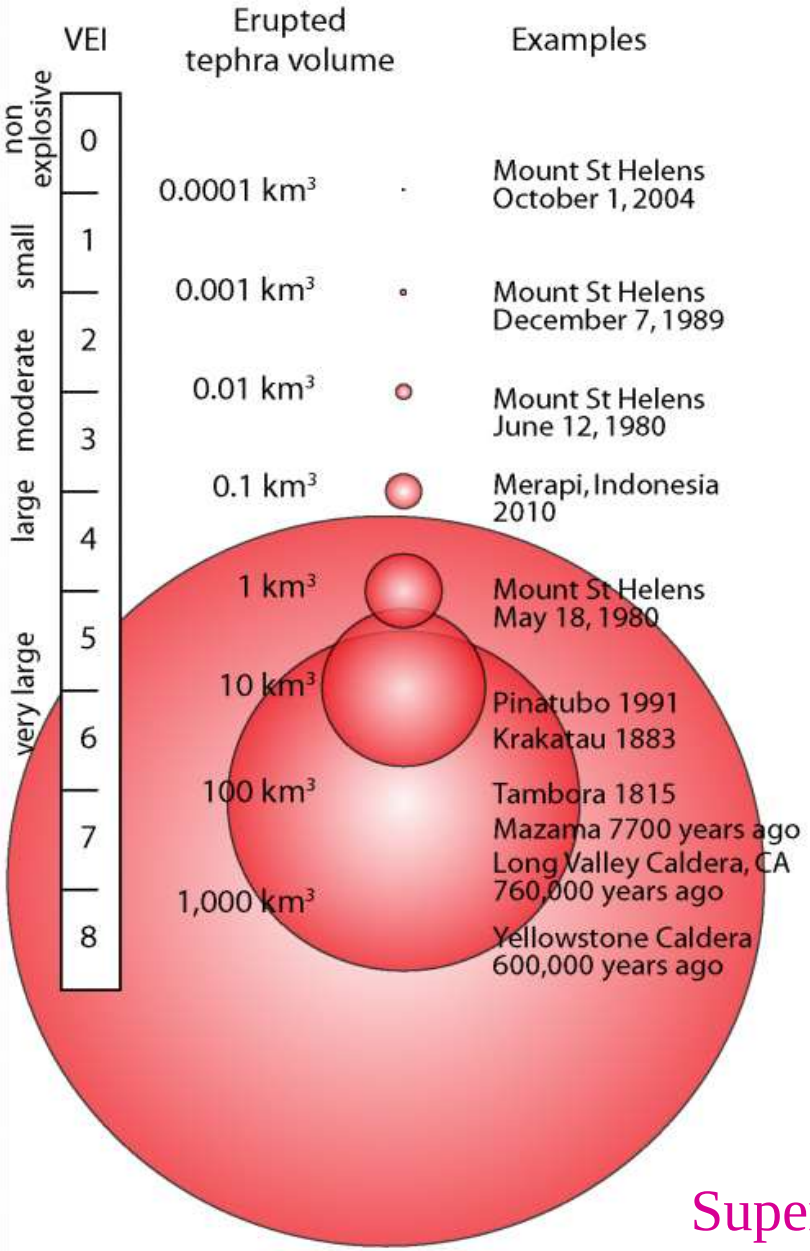
❖Rising gradually to more than 4 km above sea level, Hawaii's Mauna Loa is the largest volcano on present Earth. Its submarine flanks descend to the sea floor an additional nearly 5 km, and the sea floor in turn is depressed by Mauna Loa's great mass another 8 km. This makes the volcano's summit about 17 km above its base.

▪Volcanoes that have produced exceedingly voluminous pyroclastic eruptions (explosive eruptions and their products, e.g., pyroclastic fall or flow deposits) and formed large calderas in the past 2 million years include Yellowstone, Long Valley in eastern California (USA), Toba in Indonesia, and Taupo in New Zealand.

size comparison (in terms of DRE) of some of the world's largest volcanism



Supervolcanoes have the power to trigger widespread climate change and global starvation



Measure of volcanism

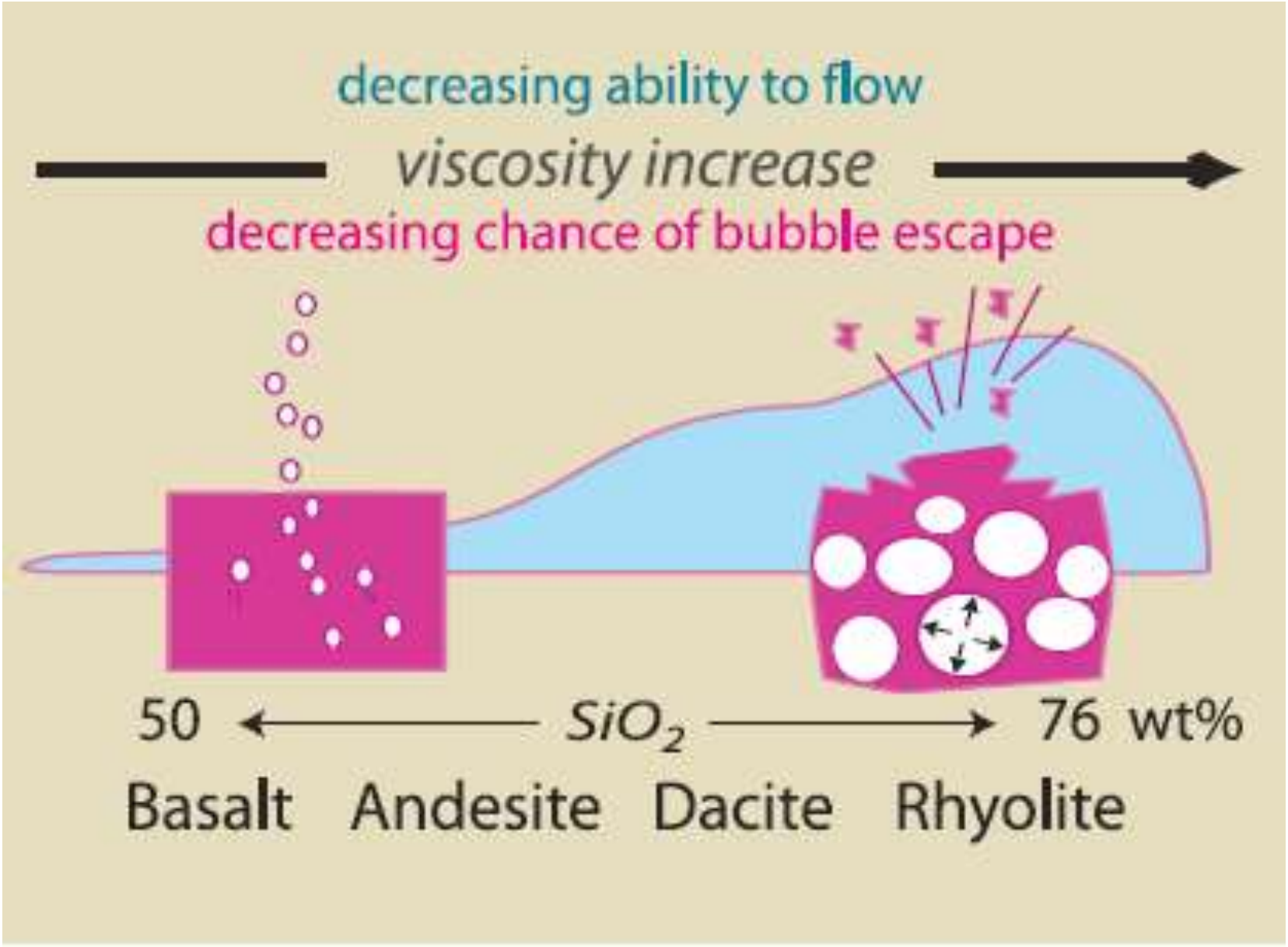
Volcanic Explosivity Index (VEI) is a relative measure of the explosiveness of volcanism eruptions.

The "supervolcano" implies a volcanic centre that had one or more supereruption of magnitude 8 on the VEI,

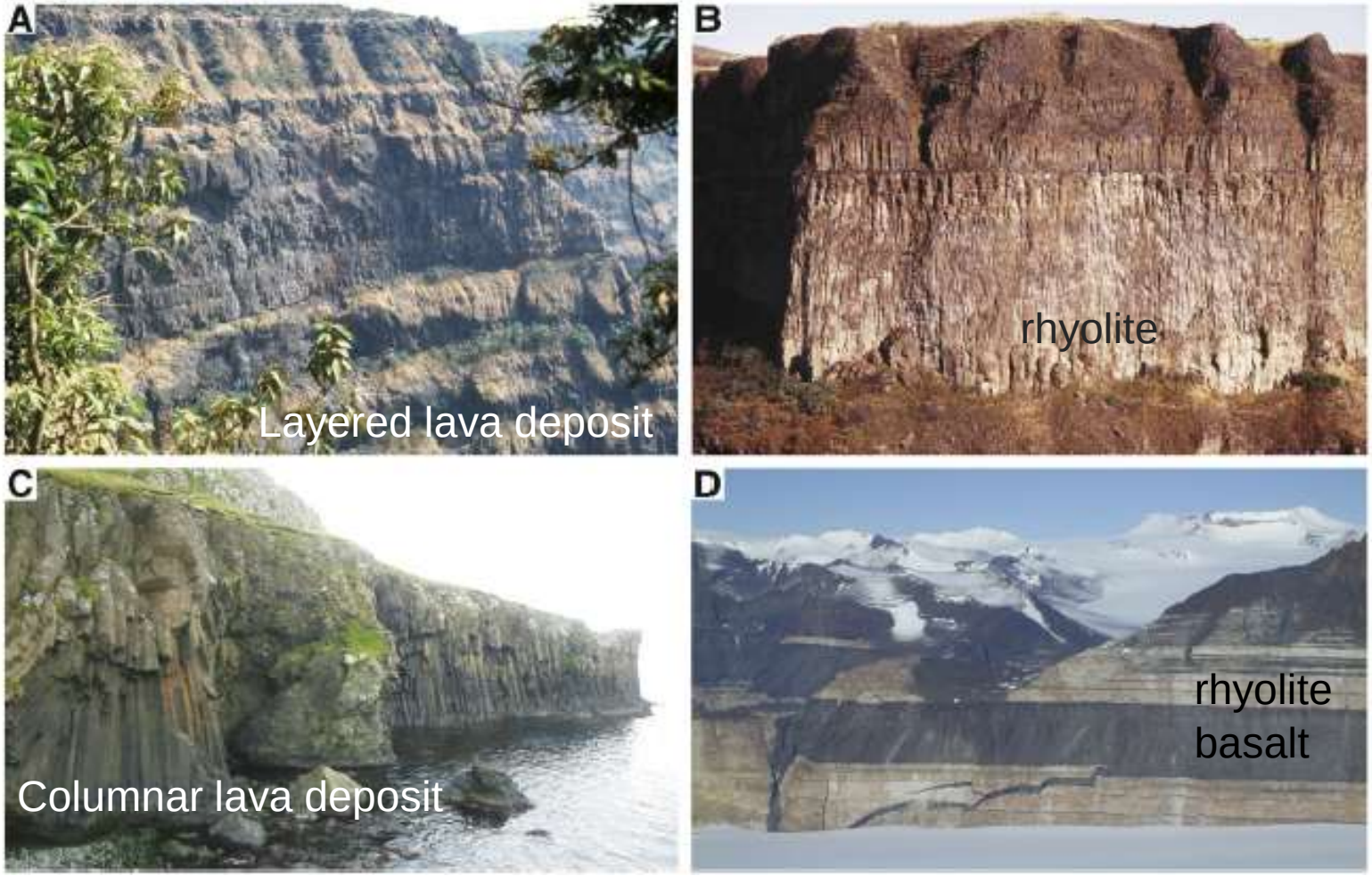
Supereruption – A single eruption that expels >1015 kg (~450 km^3) of magma; commonly explosive eruptions that invariably involve silicic magma. Such eruptions form large calderas

Supervolcanoes have the power to trigger widespread climate change and global starvation

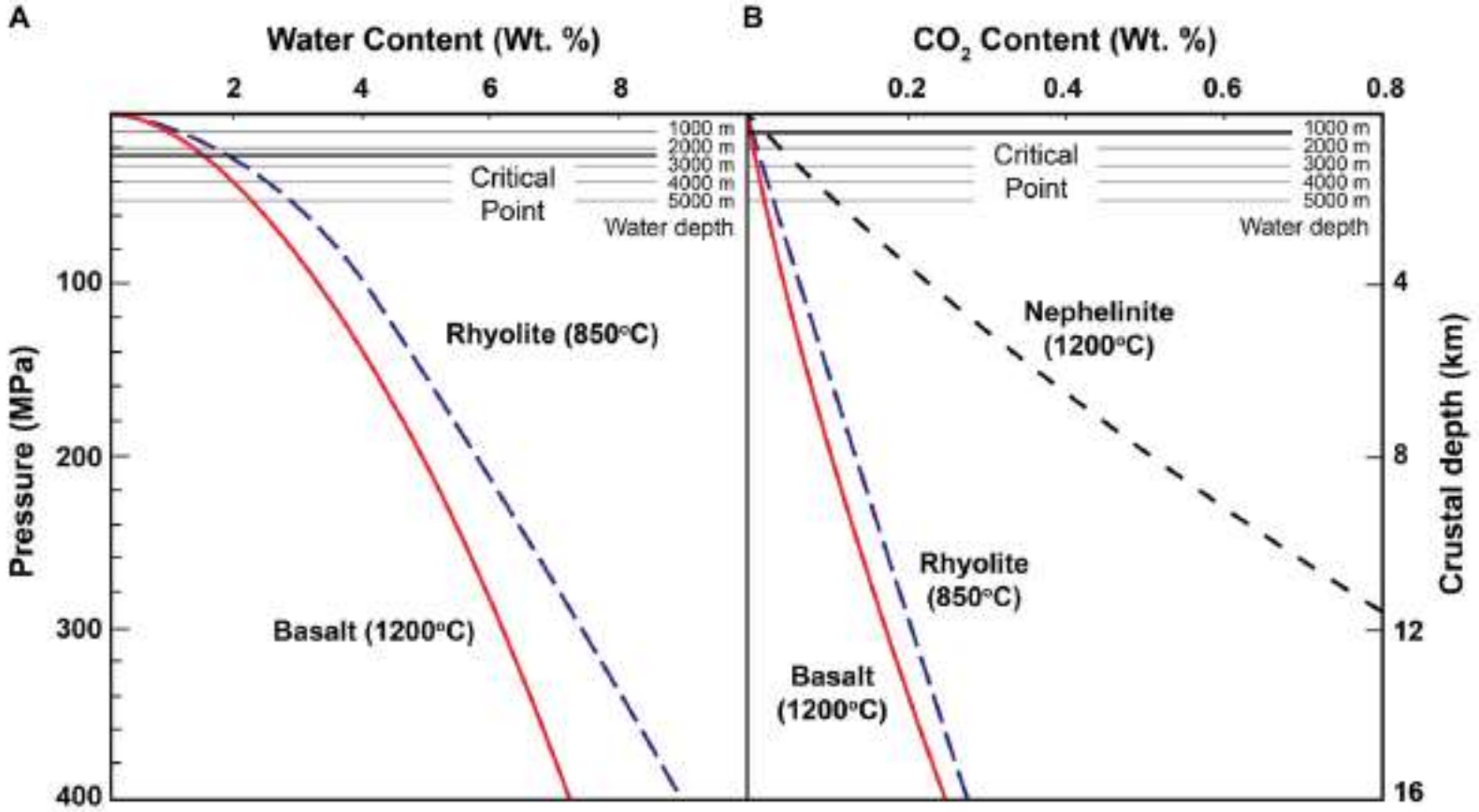
Some Physical and chemical characersitics of magma



Sequences of volcanic products in field produced in large eruptions



Photos after Bryan et al., (2010)



Volatile saturation curves for (A) H_2O and (B) CO_2 in basalt and rhyolite magmas as function of confining pressure and equivalent depth in the Earth's crust (red line for basalt, blue dotted line for rhyolite), Dissolved water content in rhyolite is more than in basalt at a given depth (except for at a very shallow depth), exsolution of which which is responsible for hugely explosive rhyolite volcanism.

Trigers for volcanism, Vesiculation, explosivity

✓ Vesiculation can occur at any depth in the crust and at any water depth if the magmatic volatile content is sufficiently high, but the state of the exsolved fluids, a trigger for volcanic eruption, depends on the depth and confining pressure

✓ Slow, non-explosive vesiculation of magma at high pressures therefore can produce highly vesicular lavas. High levels of vesicularity are not an indicator of explosivity.

✓ Exsolution of magmatic volatites at shallower depth and low confining pressure is an important trigger for large explosive volcanism on continents, which produce large pyroclastic deposits.