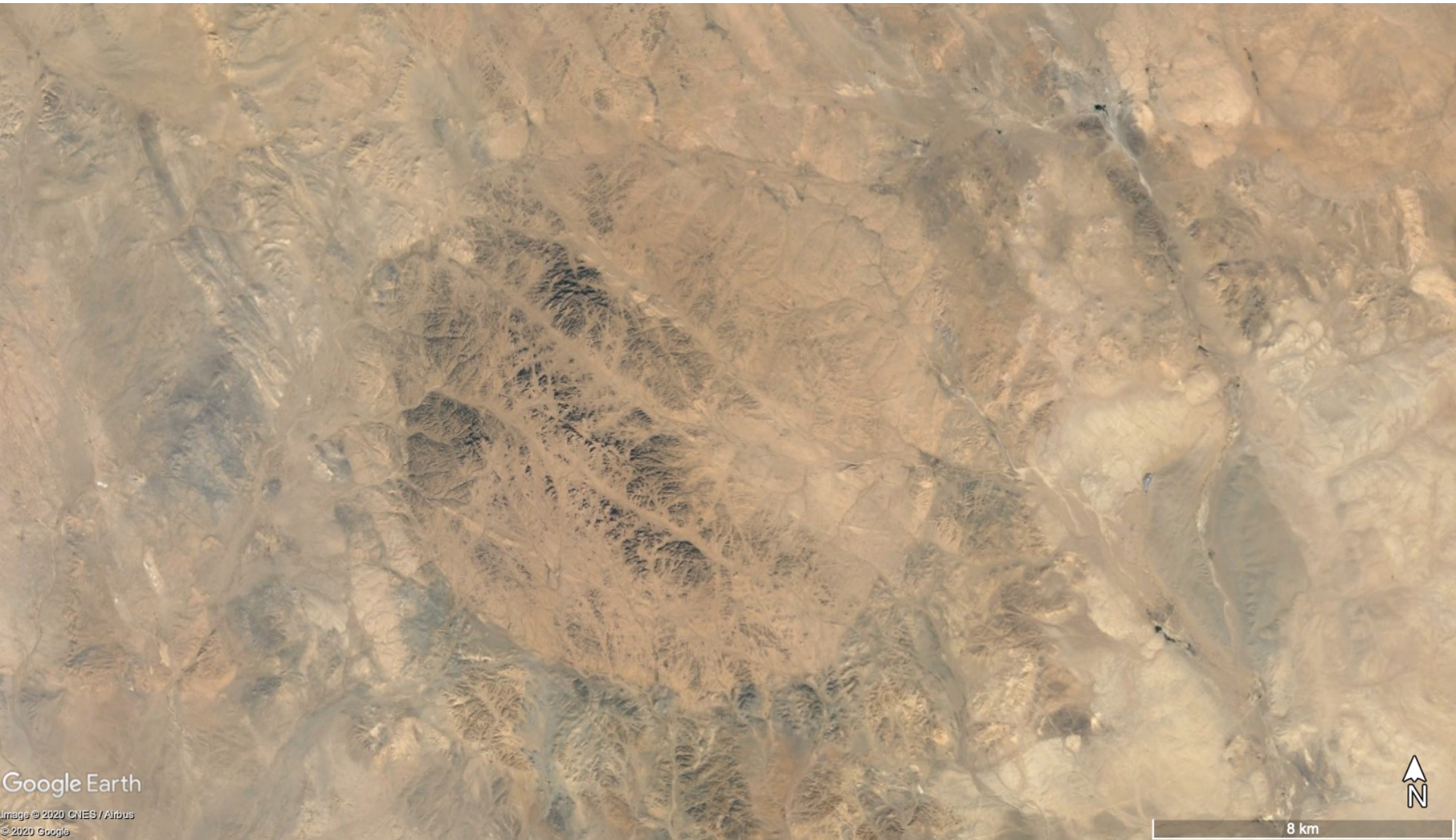
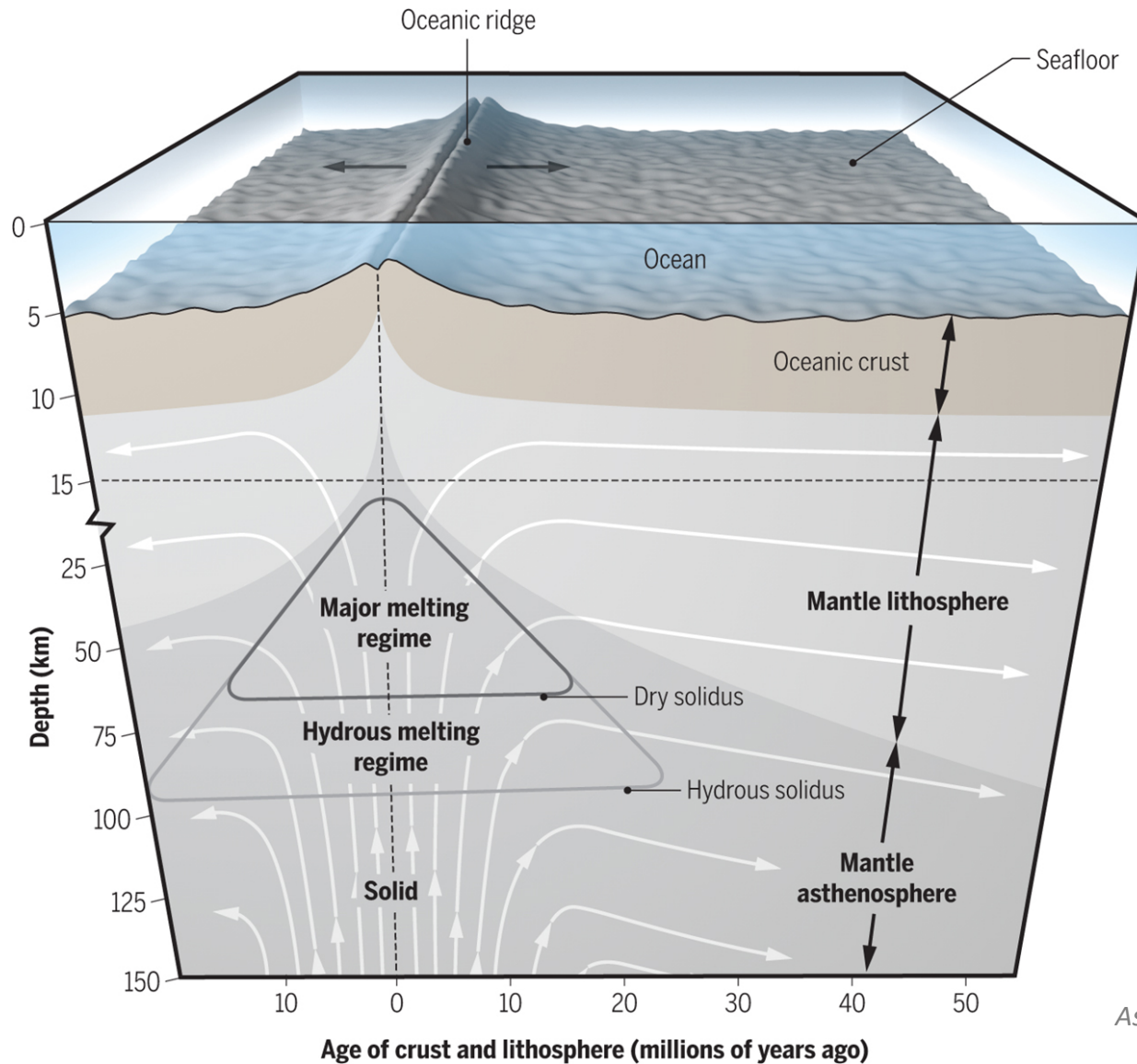




La formazione e l'evoluzione dei sistemi magmatici

Generazioni di magmi

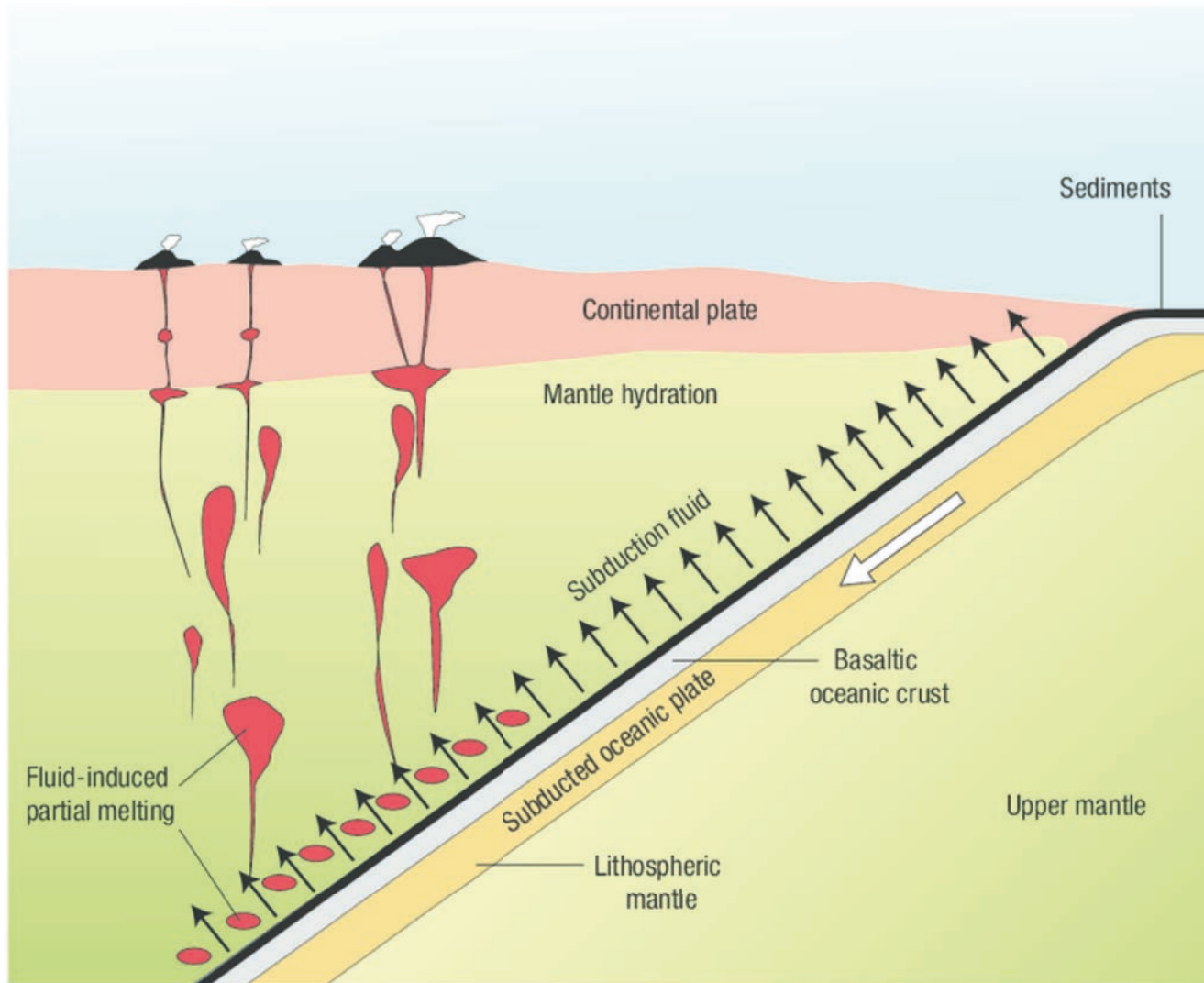
Fusione di mantello



Asimow (2017; Science)

Generazioni di magmi

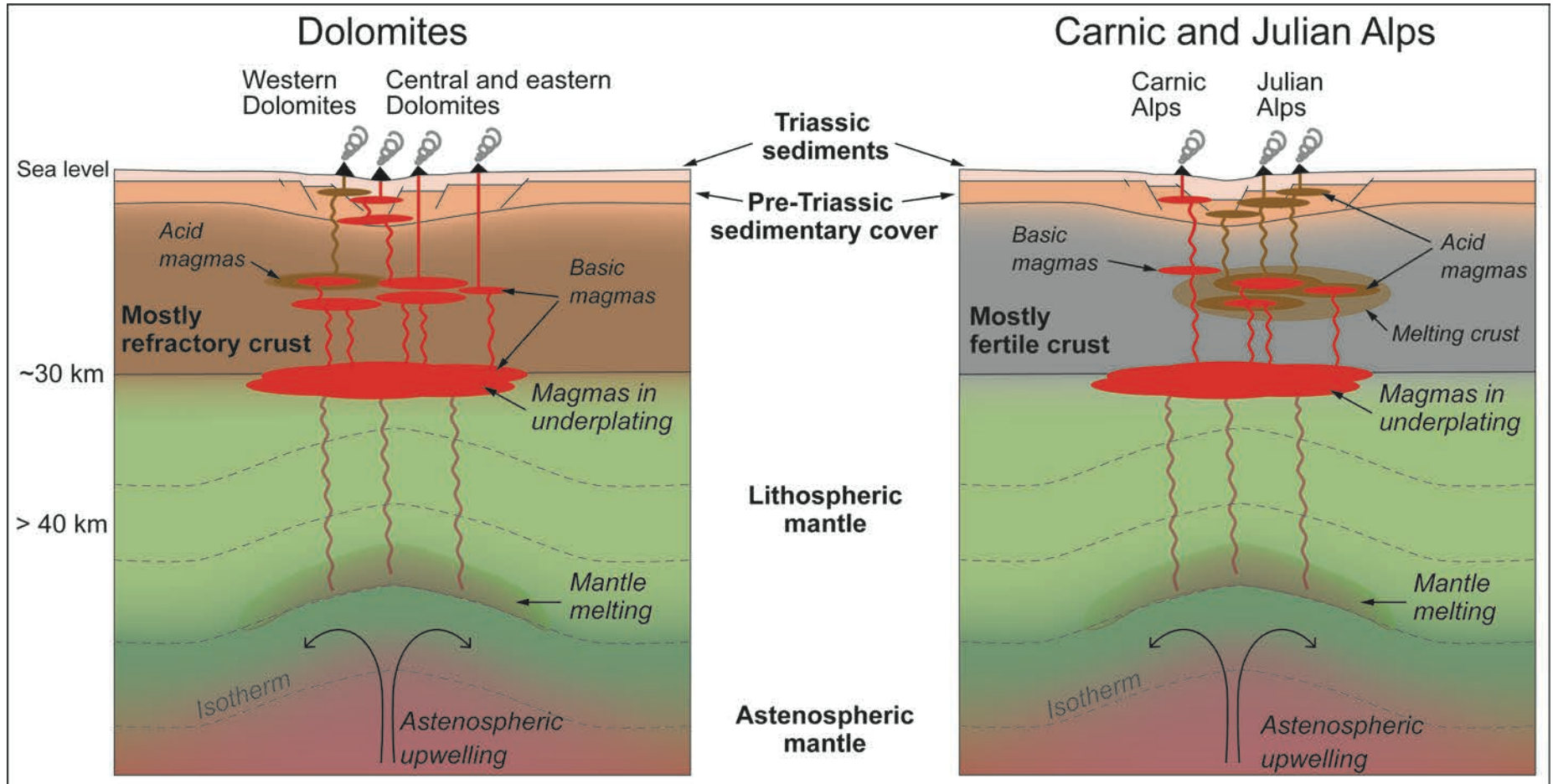
Fusione di mantello



Churikova
(2008; Nature Geoscience)

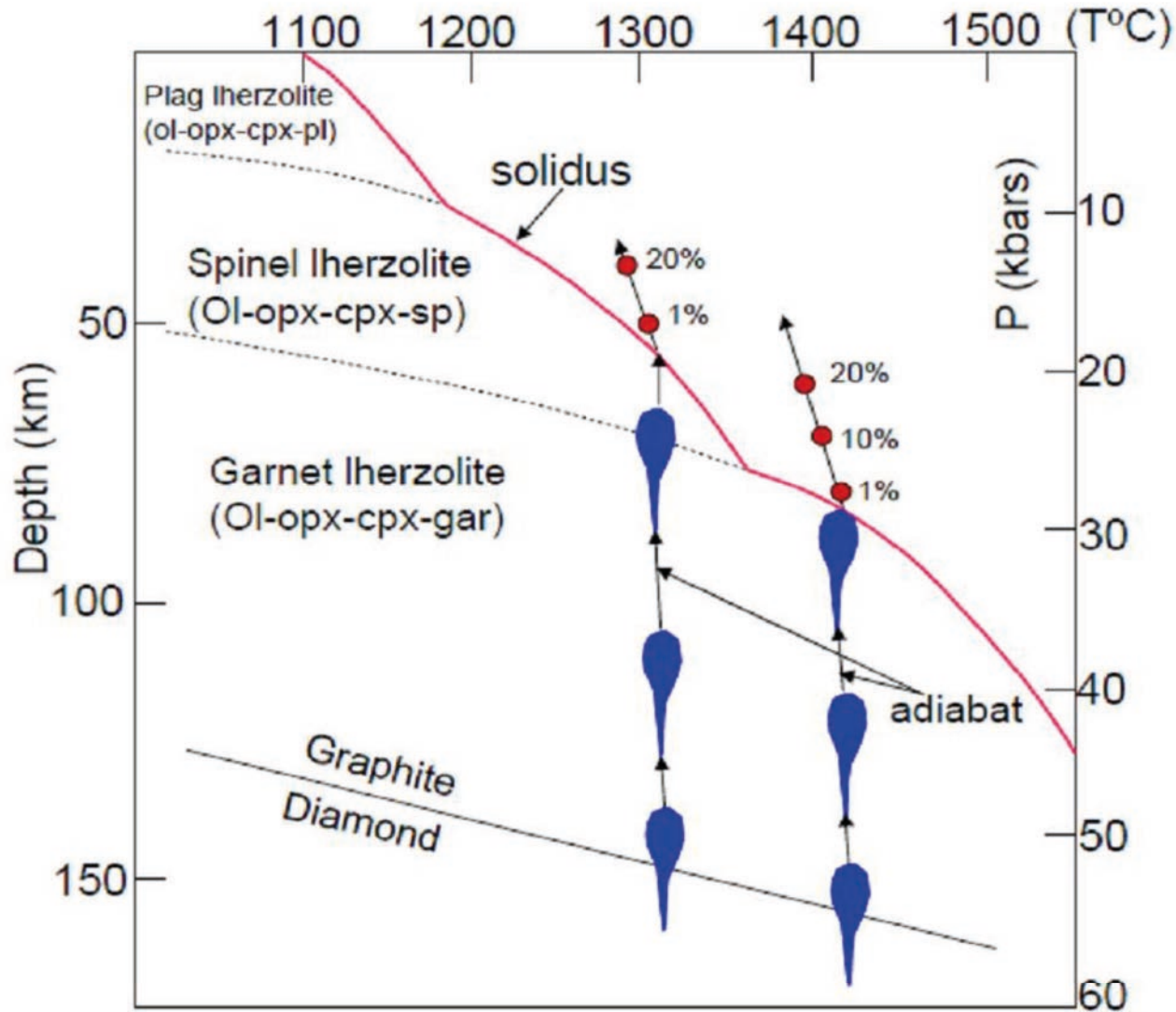
Generazioni di magmi

Fusione di mantello



Generazioni di magmi

Fusione di mantello



El-Desoky et al. (2015)

Rocce di mantello

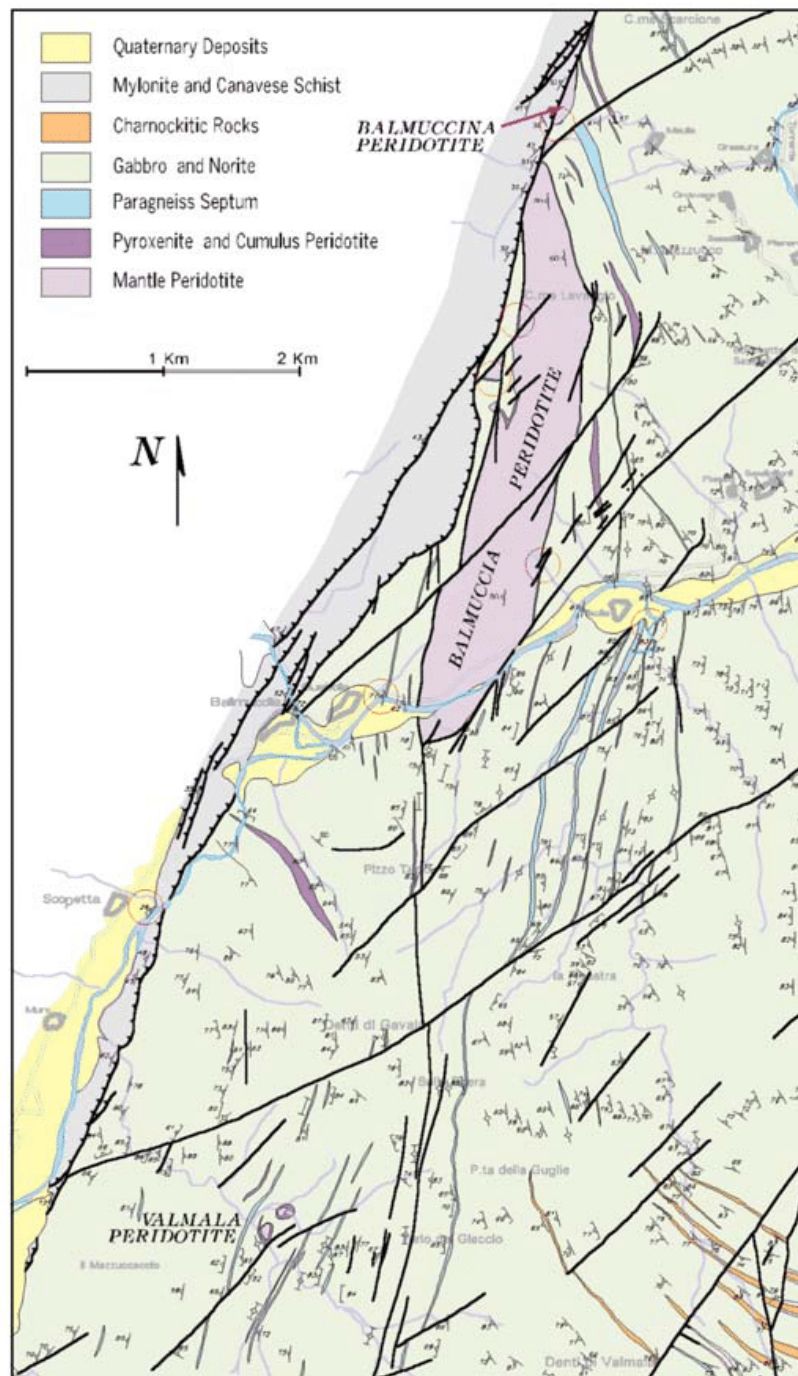


Gli affioramenti di rocce ultramafiche



Dygert et al (2016; J Pet)

Corpo peridotitico di
Balmuccia
(Ivrea-Verbano)

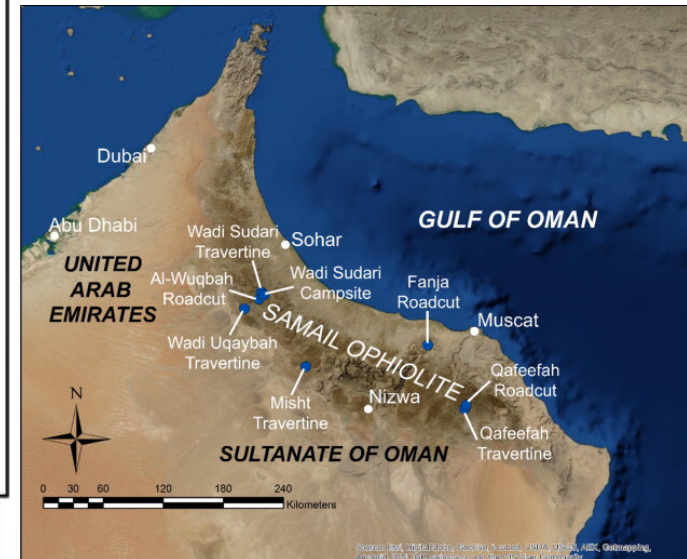
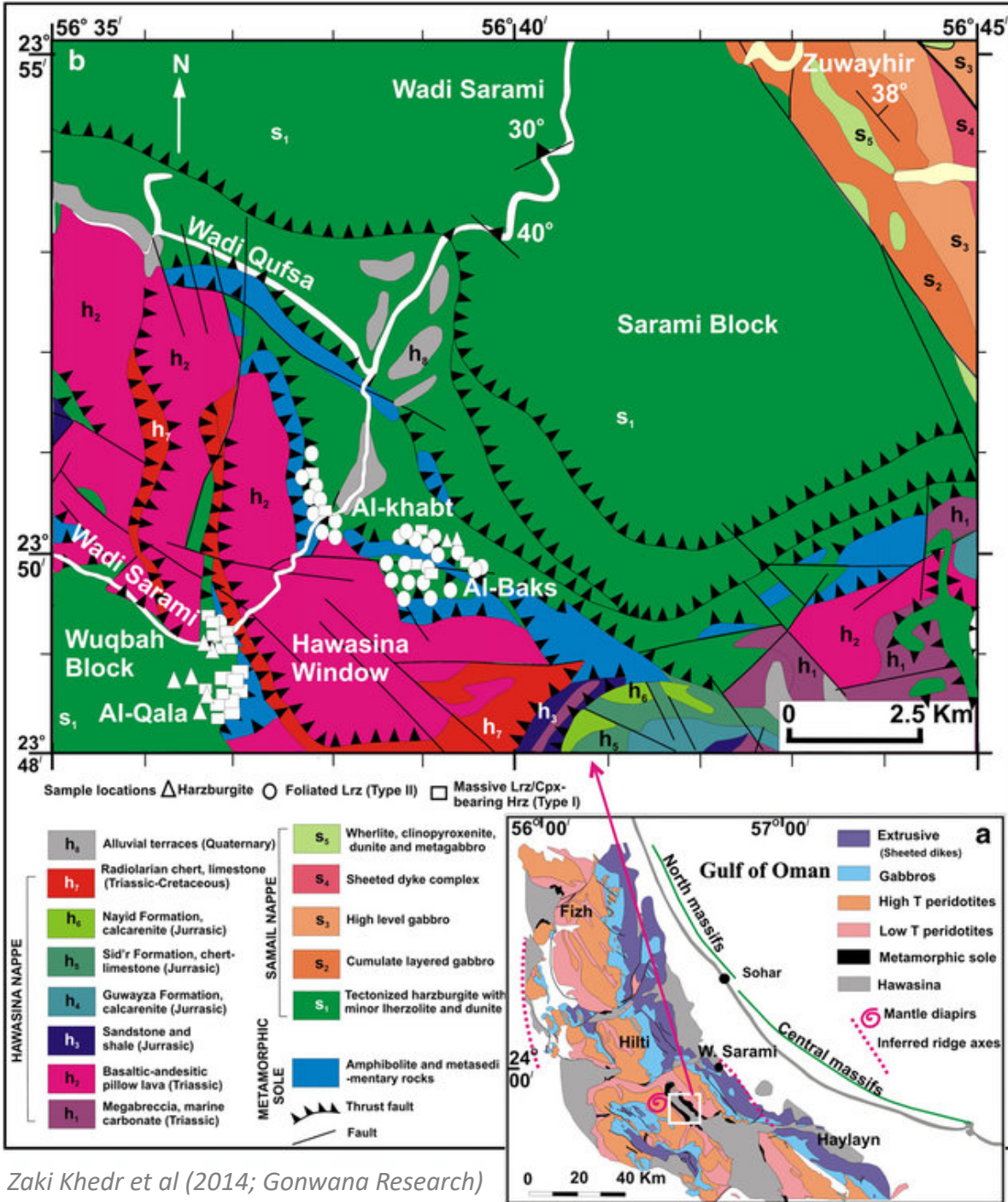


Sinigoï et al (2010)

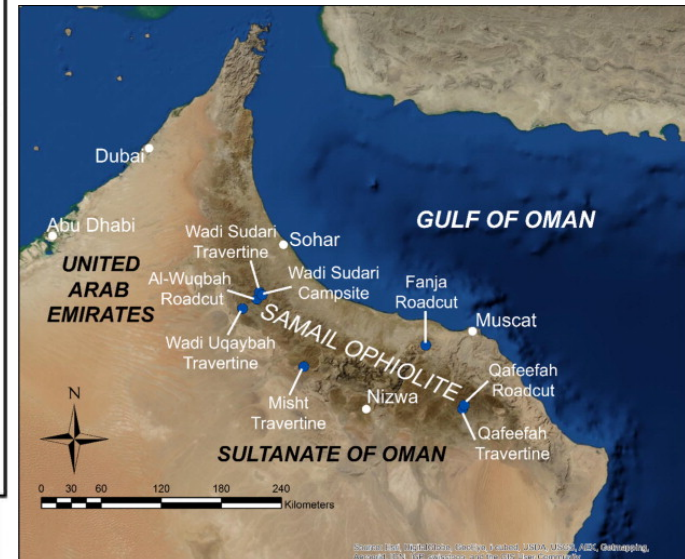
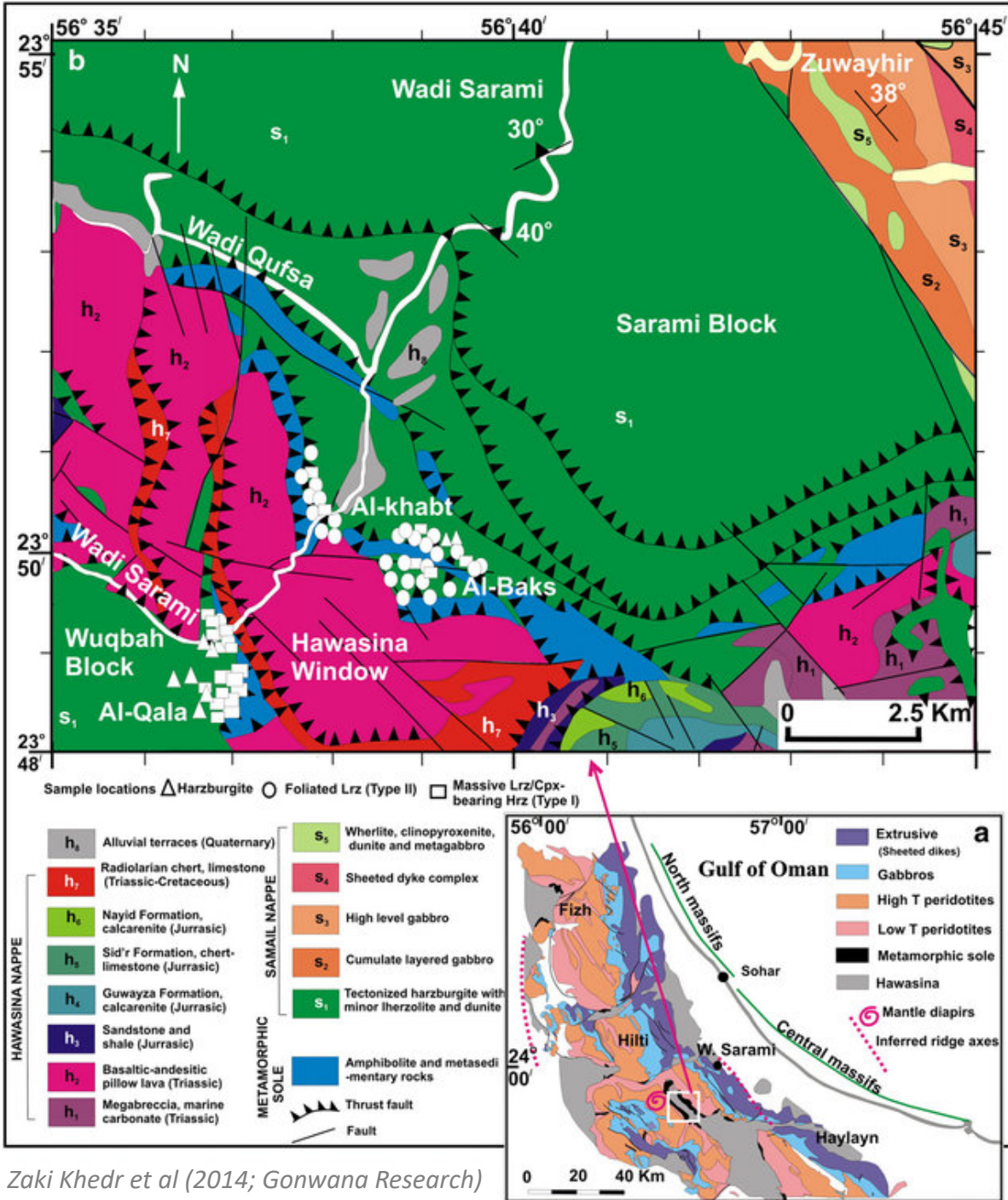


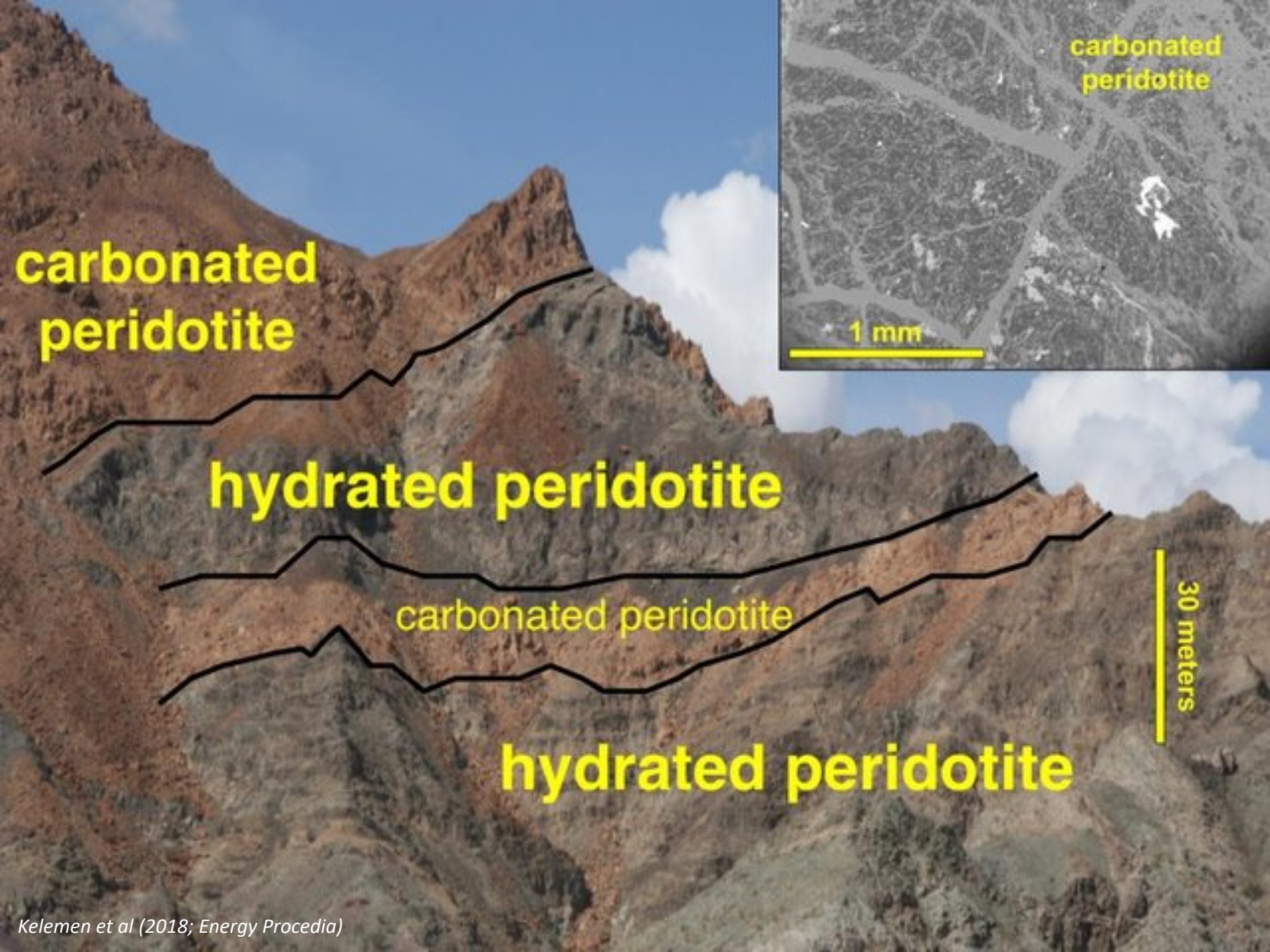


Peridotiti nelle ofioliti dell'Oman



Peridotiti nelle ofioliti dell'Oman





**carbonated
peridotite**

hydrated peridotite

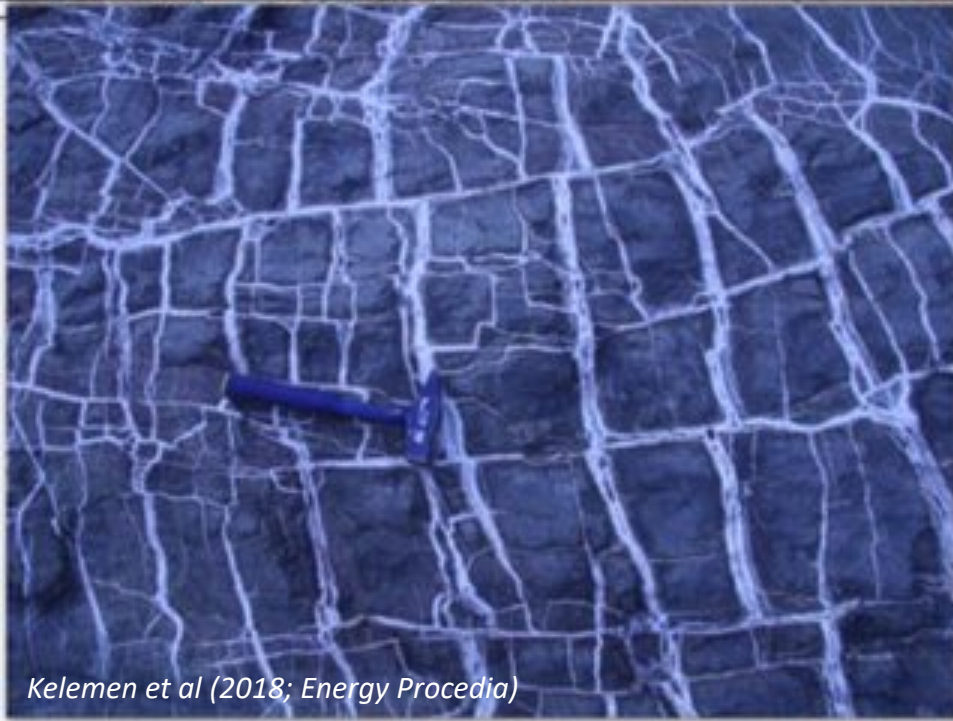
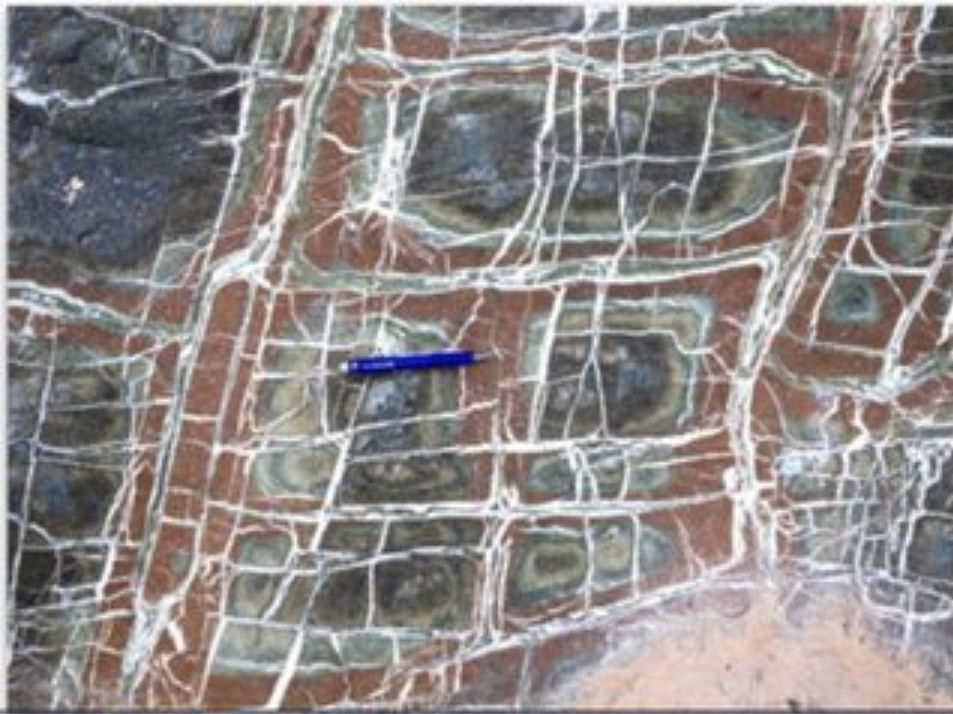
carbonated peridotite

hydrated peridotite

**carbonated
peridotite**

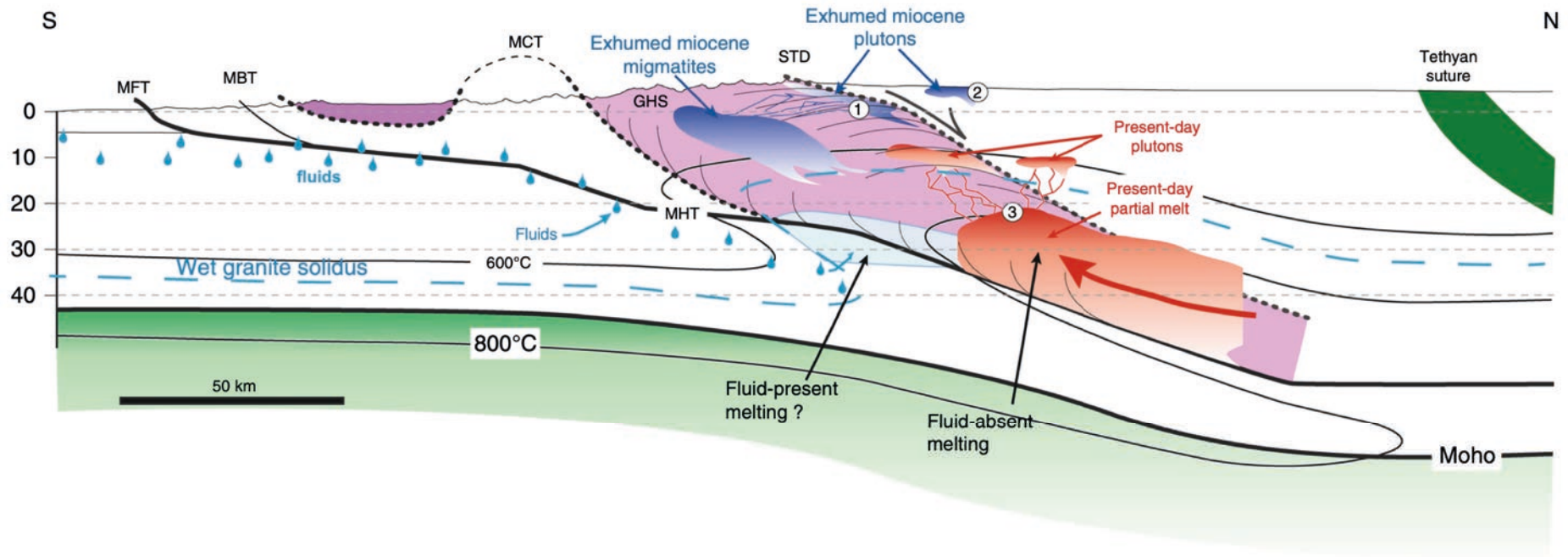
1 mm

30 meters



Generazioni di magmi

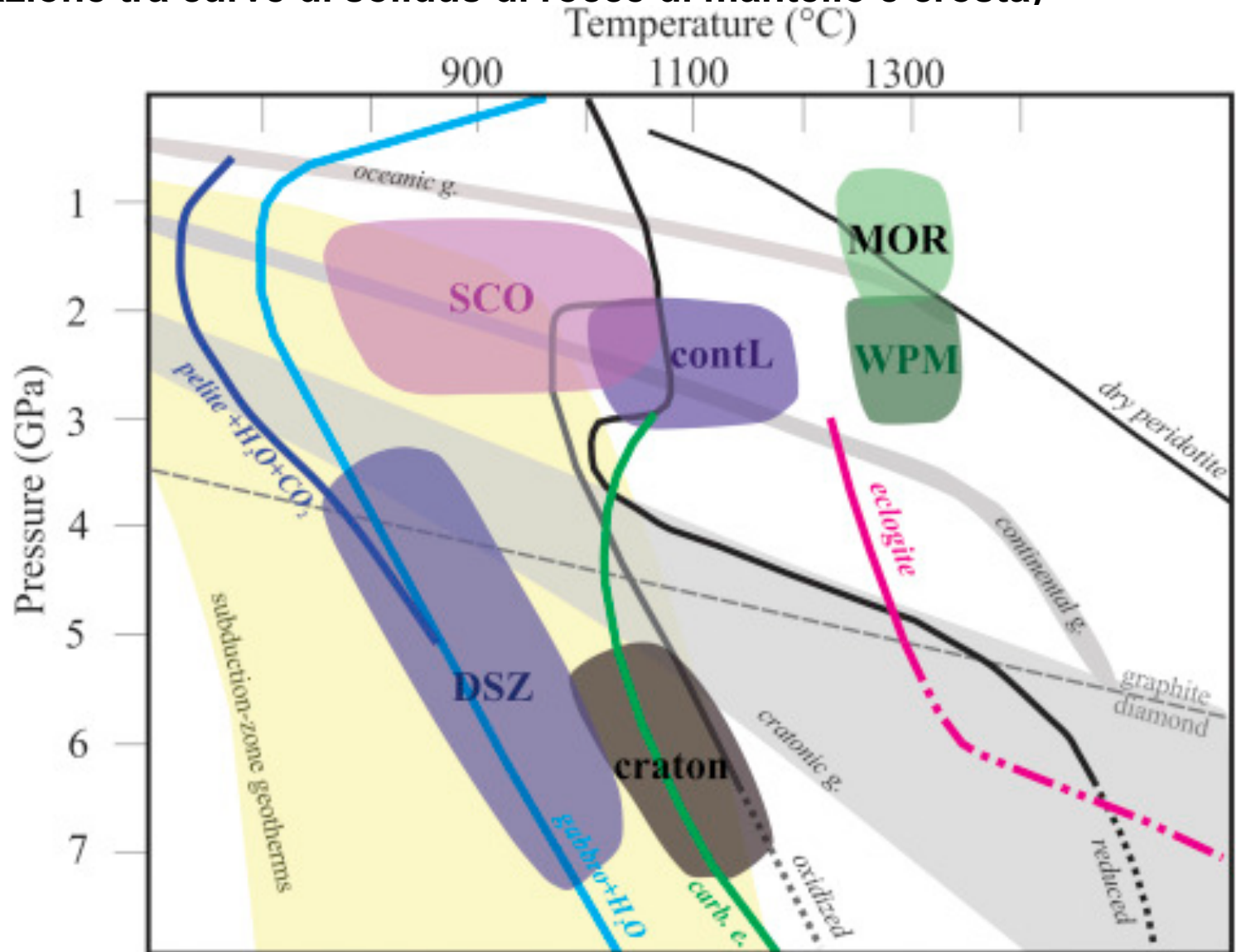
Fusione di crosta



Chen et al (2018; Nature Communications)

Generazioni di magmi

Comparazione tra curve di solidus di rocce di mantello e crosta)

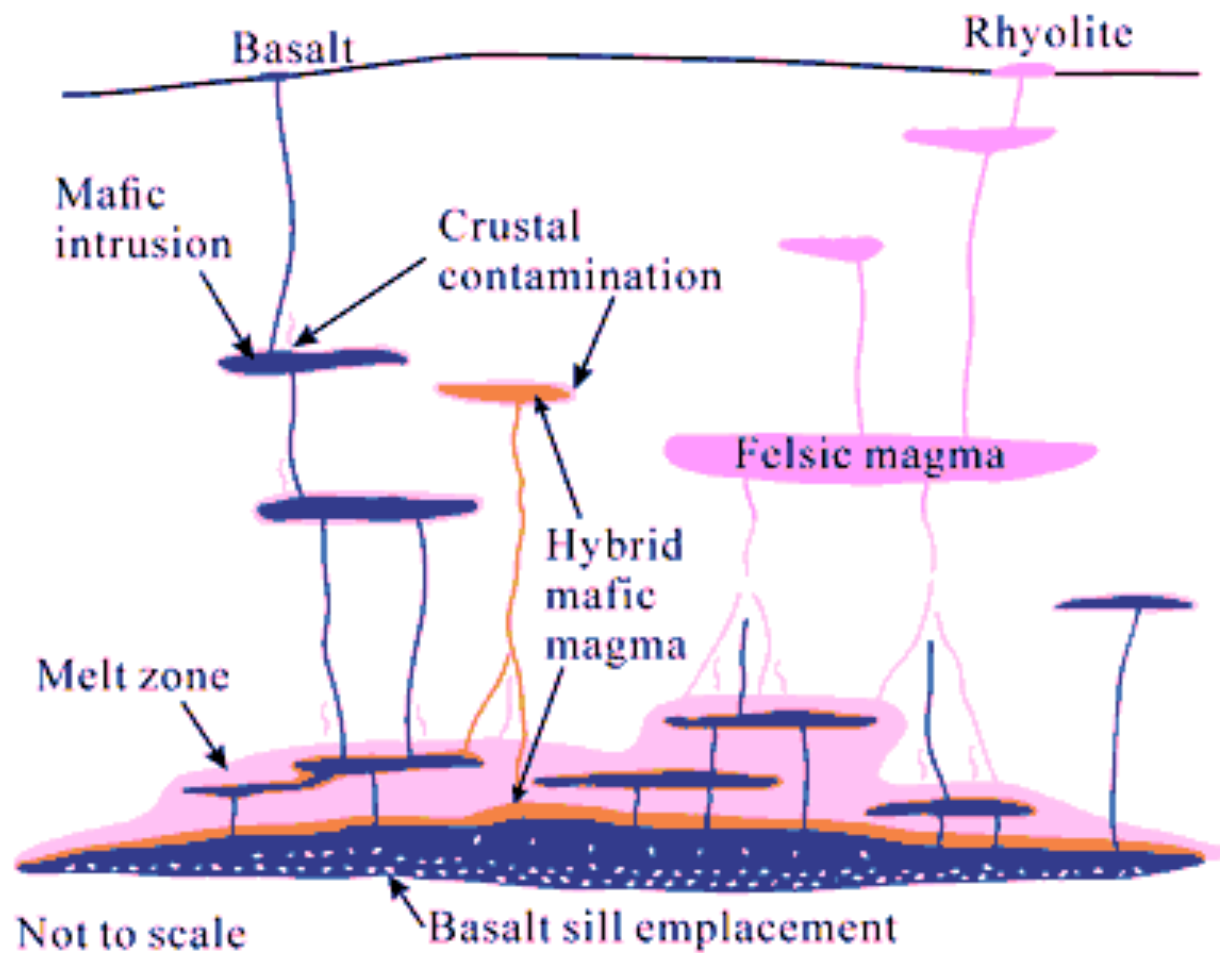






Didascalia della figura precedente:

Figure 1.10. Pressure–temperature melting conditions for various geodynamic environments (*colored/shaded areas*) compared to melting curves for mantle rocks and components of subducting lithospheric slabs and to example geothermal gradients (*thick gray lines*). Midocean ridge (MOR) and within-plate magmatism (WPM) regions are determined by upwelling asthenospheric mantle and lie above the melting points of recycled eclogite blocks. Continental lithosphere (contL) lies close to the solidus shelf and is controlled by the stability of calcic amphibole and carbonatite melts, which therefore feature prominently in noncratonic continental mantle rocks. Melting beneath the cratons is limited to high pressures and favored in oxidizing conditions. Subduction environments are divided into (1) deep subduction zones (DSZ) in which peridotite cannot melt but both igneous and sedimentary components of the subducting slab may melt, and (2) shallow collisional orogens (SCO), in which slab components may melt followed by peridotite as mantle heat accesses the new lithosphere in the postcollisional environment. See Fig. 1.3 for sources of melting curves; pelite + H₂O + CO₂ from Mann and Schmidt (2015); gabbro + H₂O from Lambert and Wyllie (1978); eclogite from Spandler et al. (2008); and carbonated eclogite from Dasgupta et al. (2004).

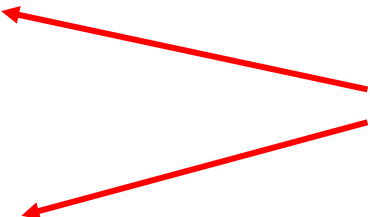


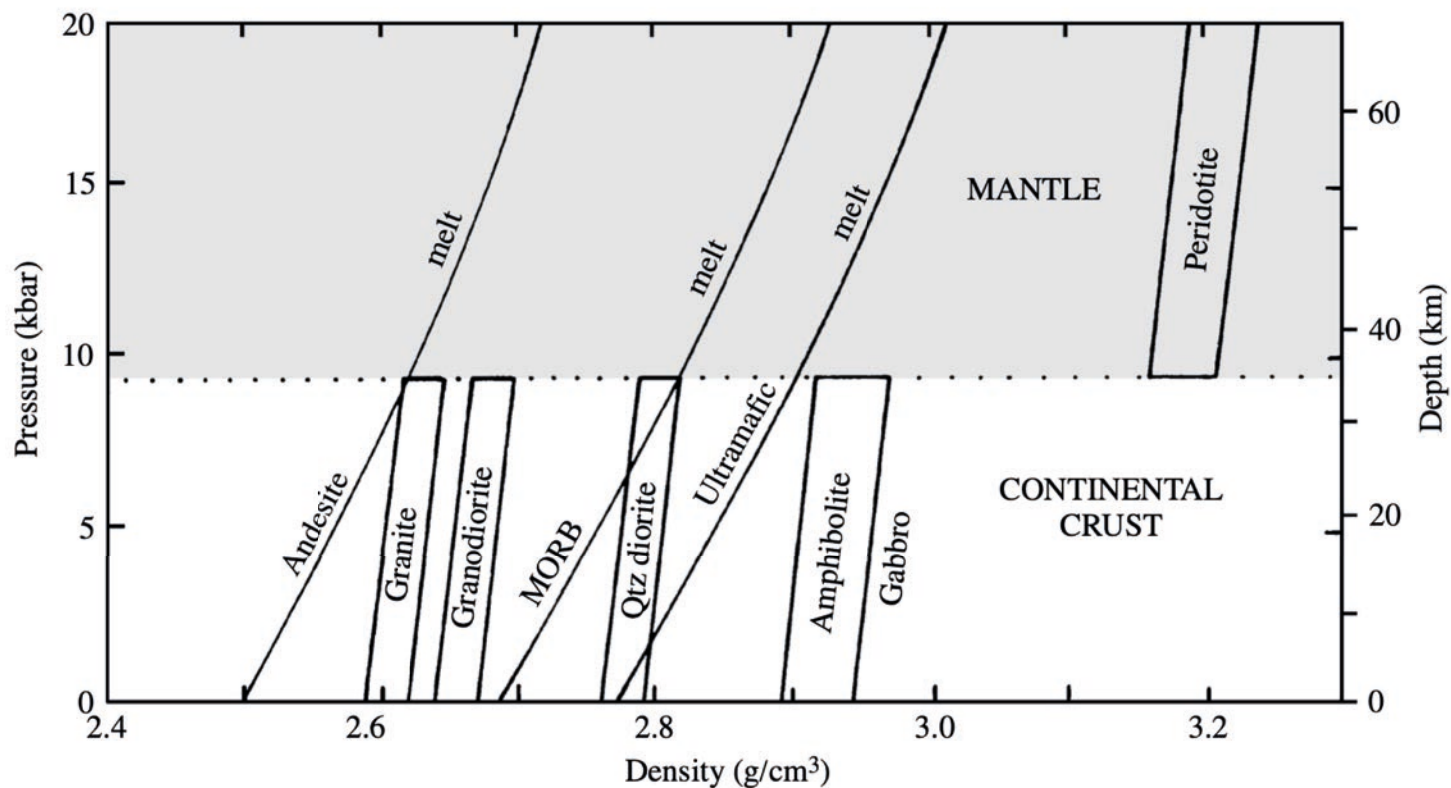
**Quali sono i fattori principali che determinano
la risalita dei magmi?**

Quali sono i fattori principali che determinano la risalita dei magmi?

- Densità
- Viscosità
- Contesto tettonico/geologico

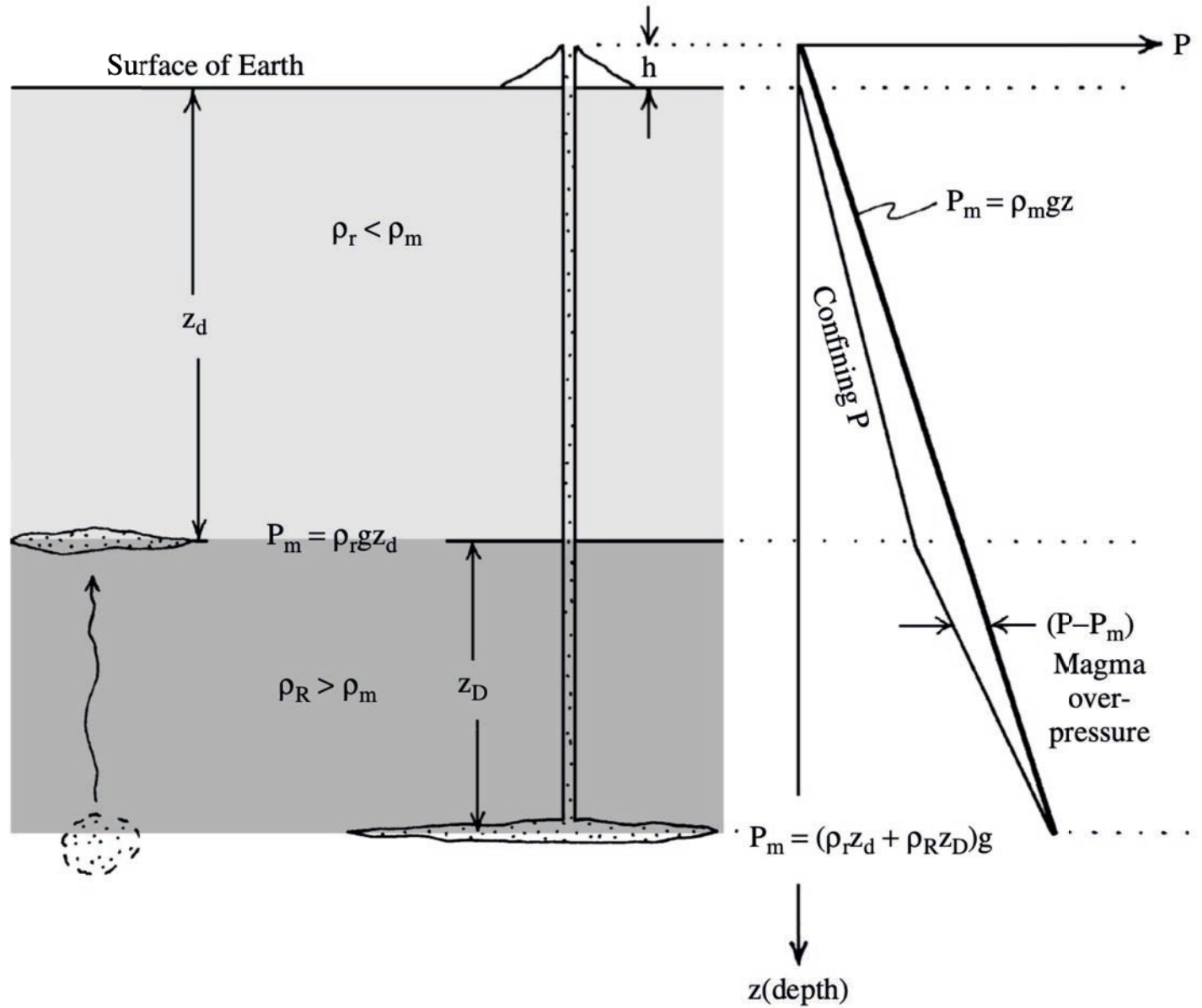
Quali sono i fattori principali che determinano la risalita dei magmi?

- Densità
 - Viscosità
 - Fattori tettonici/geologici
- Da cosa dipendono?
- 



9.1 Density relations between some rock compositions and volatile-free melts in the continental crust and uppermost mantle. Range of densities for rock types is indicated in rectangular boxes. Note the smaller compressibilities of rocks compared to melts as P (depth) increases. MORB, mid-ocean ridge basalt. Amphibolite is a metamorphic rock composed of hornblende and plagioclase that is formed by recrystallization of mafic igneous rocks (basalt, gabbro) under hydrous conditions. (Redrawn from Herzberg et al., 1983.)

Magma overpressure



La risalita dei magmi verso la superficie si manifesta in due modi principali:

Diapiri

Sono corpi magmatici che risalgono lentamente attraverso le rocce ospitanti tendenzialmente duttili e altamente viscosi nella crosta e nel mantello.

Dicchi

Sono corpi magmatici che risalgono attraverso fratturazioni subverticali in rocce fragili.

Table 9.1 Comparison of Sheet Intrusion (Diking) and Diapirism in the Continental Crust

ASPECT	SHEET INTRUSION	DIAPIRISM
Most common magma composition	Basalt	Granitic
Rheologic behavior of country rock	Brittle (elastic)	Ductile or viscoplastic
Viscosity contrast between country rock and magma	Many orders of magnitude	A few orders of magnitude
Ascent velocity	0.1–1 m/s	0.1–50 m/y
Time for magma ascent	Hours to days	10^4 – 10^5 y
Factors controlling ascent velocity	Magma viscosity and density contrast with country rock; dike thickness	Country rock ductile strength and thickness of boundary layer around diapir
Effect of state of stress on path of magma transport	Sheet perpendicular to least principal stress, σ_3	Probably slight
Country rock deformation	Nil	Substantial penetrative ductile, chiefly in boundary layer
Nonmagmatic example	Hydrothermal quartz vein	Salt dome

Intrusioni tabulari

Le intrusioni tabulari (*sheet intrusions*) si definiscono come tali se hanno dei rapporti spessore/lunghezza nell'ordine di $10^{-2} - 10^{-4}$.

Un **dicco** è un'intrusione che taglia in modo discordante le strutture planari, come la stratificazione, della roccia incassante. I dicchi sono anche le intrusioni tabulari che tagliano strutture massive e isotropiche come i graniti.

Un **sill** (o filone-strato), d'altra parte, è una intrusione tabulare concordante con le strutture planari della roccia incassante.

Lava-capped plateau

Volcanoes

Lava-capped plateau

Dike

Sill

Laccolith

Dike

Dike

Sill

Batholith

Concordant
Discordant

Batholith

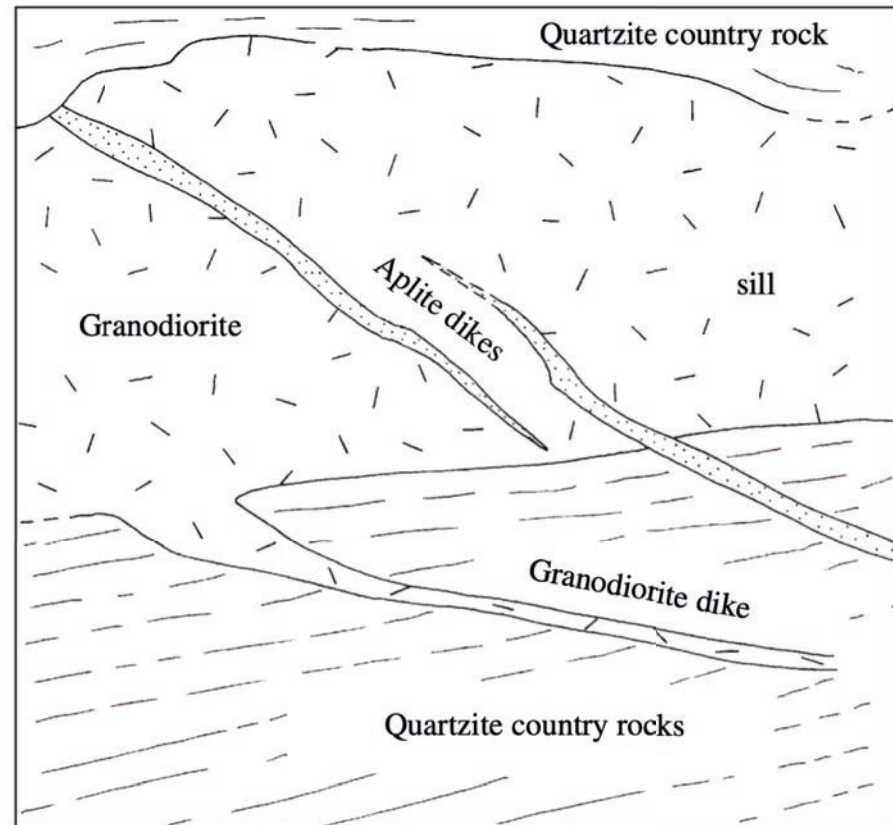
Country Rock

Stock

Veins

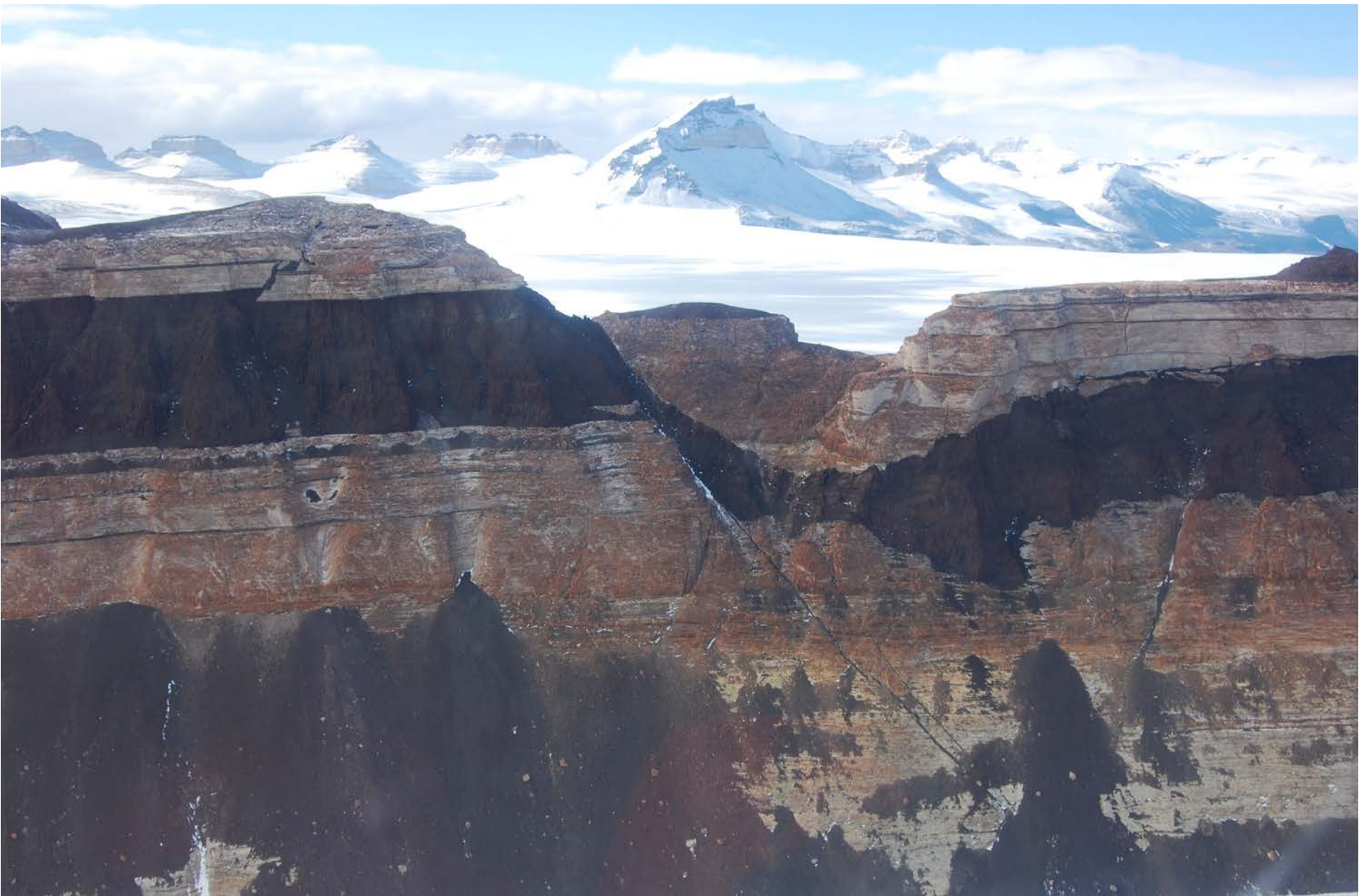
ezi

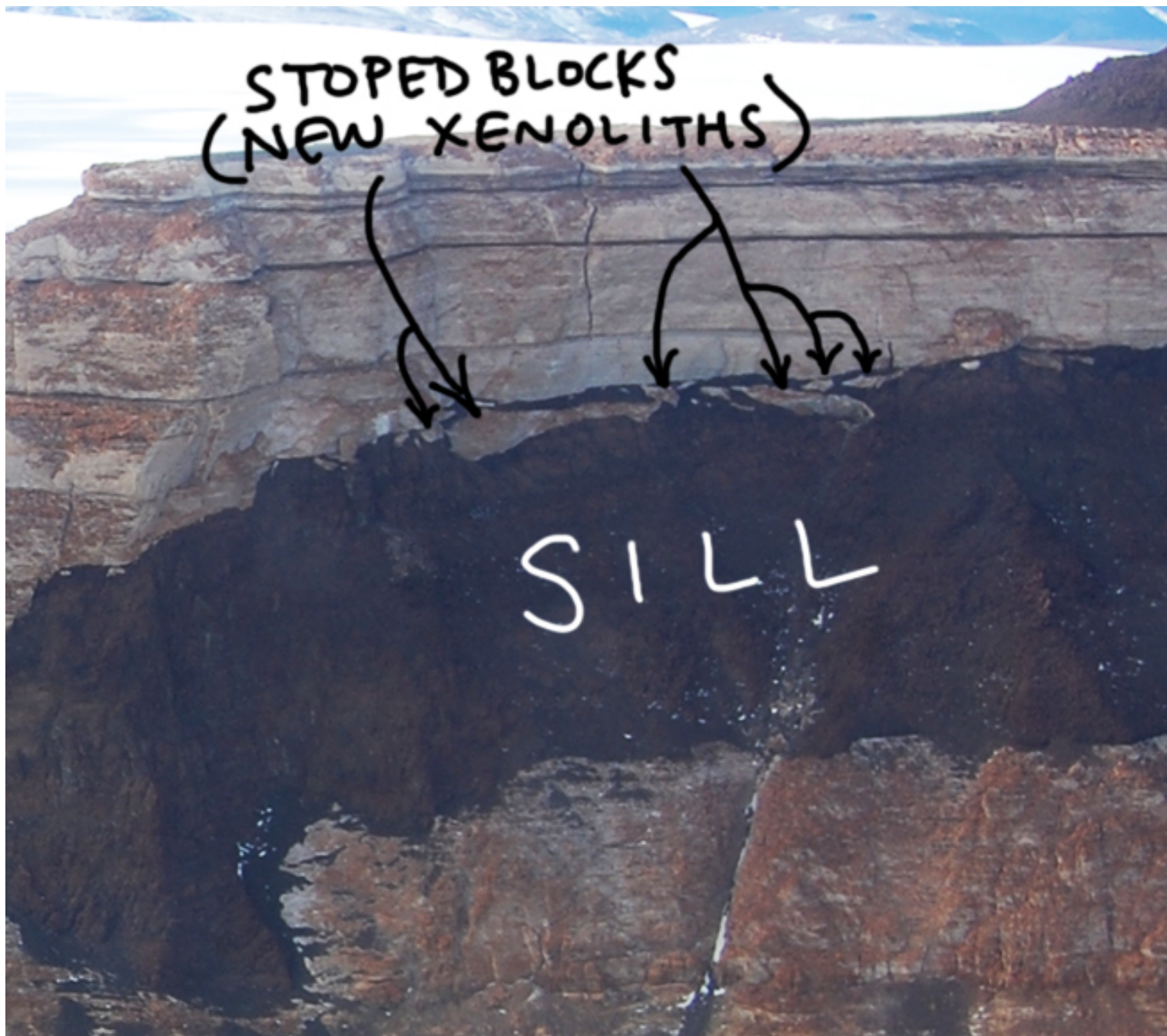
<https://volcanohotspot.wordpress.com/2017/07/06/batholith-lopolith-sill-or-dike-intrusions-2/comment-page-1/>

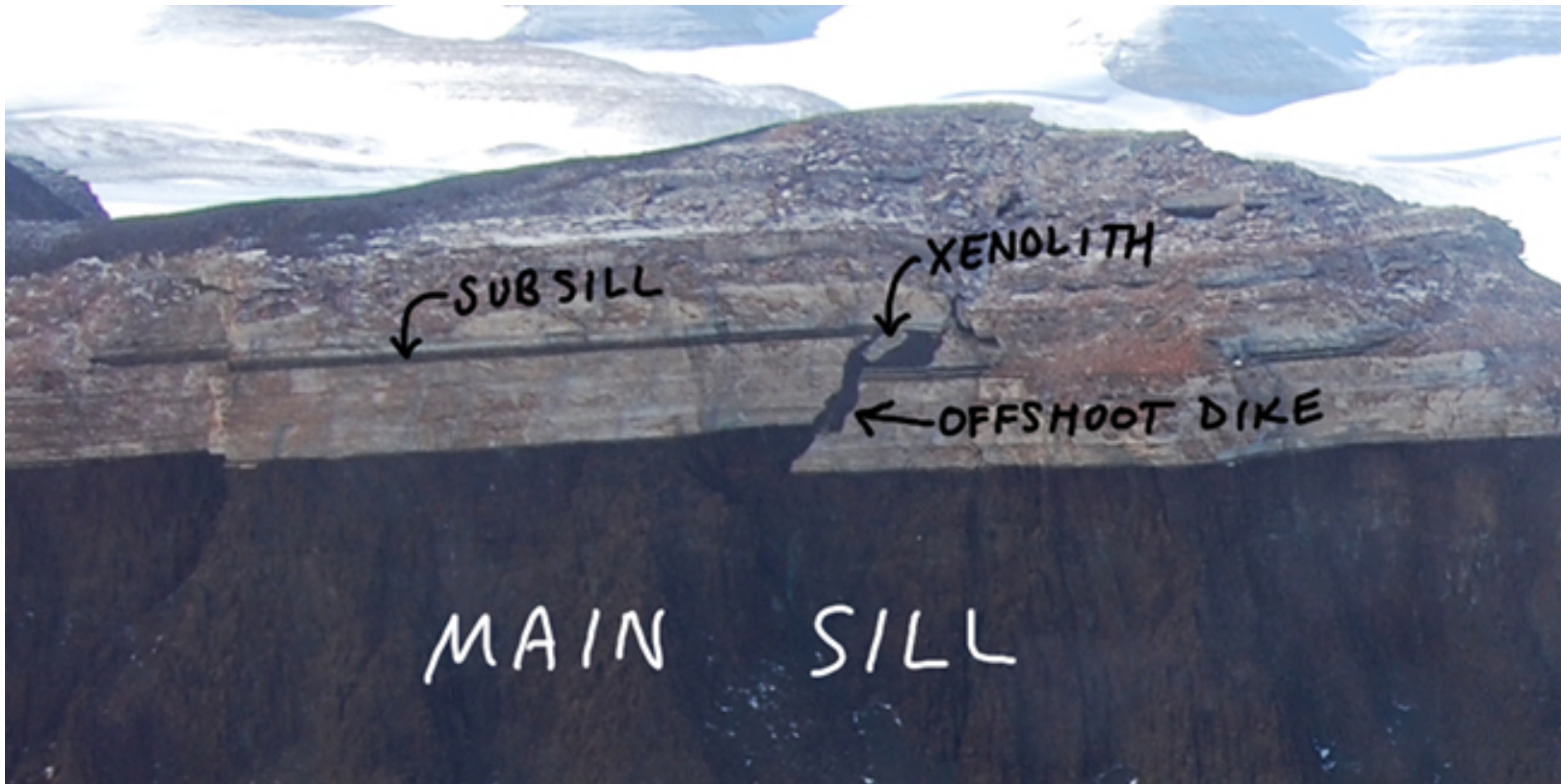


9.3 Sill and dikes. A **sill** of granodiorite intruded concordantly with layering in quartzite host rock and a smaller offshoot **dike** penetrating discordantly across layering. Thin subparallel dikes of leucocratic granite aplite cut across more mafic granodiorite and layered country rock. Note sharp contacts. Camera lens cap in lower left for scale. (a) Photograph. (b) Annotated sketch.

Best (2003)







https://blogs.agu.org/mountainbeltway/files/2015/01/DSC_0893.jpg

Intrusioni tabulari

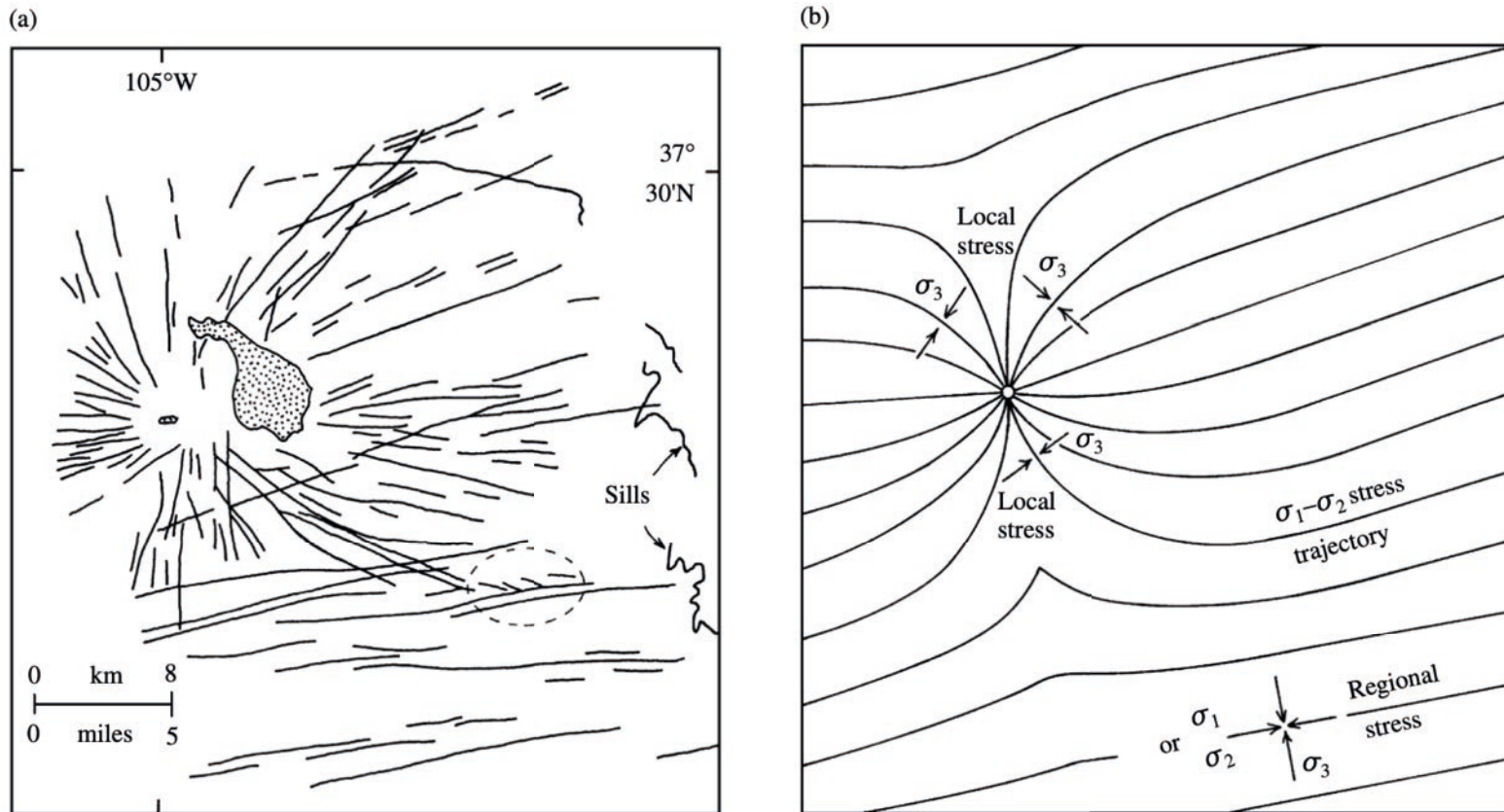
Uno **sciame di dicchi** (*dyke swarm*) consiste in una decina fino a un centinaio di dicchi messi in posto più o meno contemporaneamente durante un episodio intrusivo individuale. I dicchi in uno sciame possono avere orientazioni irregolari, essere più o meno paralleli o radiali. Gli sciami di dicchi radiali giganti sono ipotizzati essere relazionati a mantle plumes associati ad estensione continentali.

Lo spessore dei dicchi può variare da qualche cm al centinaio di metri (tipicamente sono nell'ordine del metro). Nel caso di sciami giganti, la loro estensione può arrivare fino ai 2000 km.

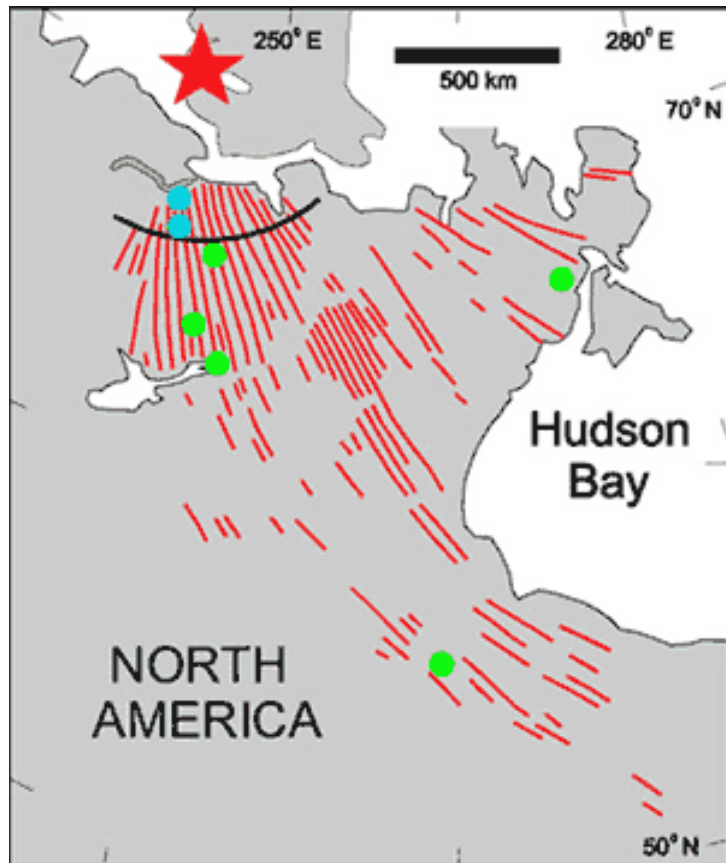
I dicchi di alimentazione (*feeder dykes*) sono quelli che alimentano i sills e le altre intrusioni magmatiche. Ad esempio, i dicchi basaltici sono spesso le strutture che permettono la crescita di vulcani continentali, oceanici e dello stesso fondale oceanico.



http://earthwise.bgs.ac.uk/index.php/Dykes,_dyke_swarms_and_volcanic_plugs,_Palaeogene_volcanic_districts_of_Scotland#/media/File:P580470.jpg



9.6 Radial and parallel dike swarms. (a) Subvertical dikes were emplaced at 28 to 20 Ma around **central intrusions** of the Spanish Peaks (stippled) in south central Colorado. Flow markers (aligned tabular phenocrysts, elongate vesicles) in the dikes indicate the central intrusions as the source of the radially diking magma. Most dikes consist of segments a few meters to several kilometers long; many segments are *en echelon* but cannot be shown on this small-scale map except some unusually well-expressed ones enclosed by the dashed-line ellipse. An origin for *en echelon* dikes is shown in Figure 9.9. (Redrawn from Smith, 1987.) (b) Theoretical stress analysis. Central intrusion (open circle) is responsible for a *local stress* field that allows for radial diking. The central intrusion perturbed a *regional stress* field that controlled emplacement of the mostly older swarm of subparallel east-northeast-striking dikes mainly of more mafic magma. Trajectory lines are traces (intersections) in the horizontal plane of vertical surfaces parallel to σ_1 and σ_2 . Because these surfaces are perpendicular to σ_3 , they are potential avenues for magma intrusion. Note that most radial dikes are oriented nearly parallel to the regional $\sigma_1 = \sigma_2$ trajectory. (Redrawn from Odé, 1957.)



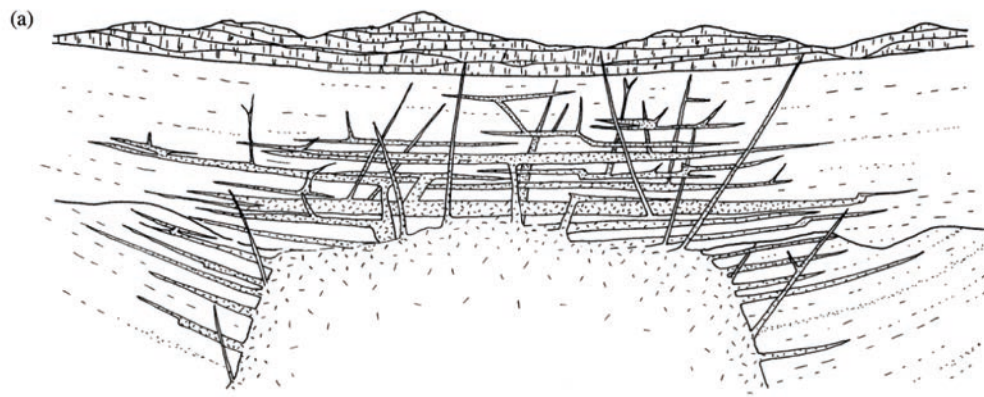
<http://www.mantleplumes.org/GiantRadDykeSwarms.html>

Intrusioni tabulari

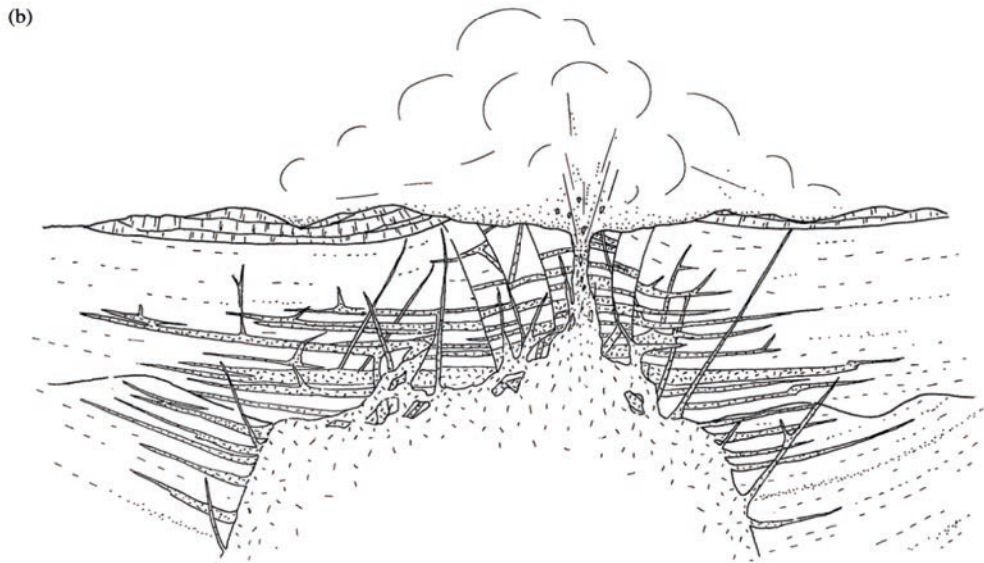
Alcuni dicchi possono anche non raggiungere la superficie o altre intrusioni magmatiche. Esse possono essere chiamate intrusioni «cieche» (?) (*blind intrusions*)

Anche gli **sciami di sills** hanno estensioni variabili come gli sciami di dicchi.

Nei casi estremi, come in alcuni sciami presenti in Antartide, Sud Africa e Tasmania, i singoli sills possono avere spessori fino a 300 m e occupare aree più grandi di 15,000 km².



Best (2003)



9.5 Schematic cross sections illustrating inferred relations among main intrusion, overlying dike-sill swarm, and layered volcanic rocks in the Miocene-Pliocene Tatoosh complex in Mount Rainier National Park, Washington. (a) In an early stage in the rise and emplacement of the intrusion, magma is lodged in an overlying dike-sill complex, advectively heating the roof of older volcanoclastic rocks. (b) In a later stage, the main mass of magma has continued to rise by **stopping** into its dike-sill complex and by **doming** the sills, their older host rock, and overlying volcanic rock layers. Note stopped blocks of roof rock in the main intrusion. Magma has broken through to the surface in an explosive eruption. A still later stage can be envisaged in which the still ascending magma intrudes its own volcanic cover. (Redrawn from Fiske et al., 1963.)

Link all'affioramento 3D