

ERUPTIVE MECHANISM OF PHREATOMAGMATIC VOLCANOES FROM THE PINACATE VOLCANIC FIELD: COMPARISON BETWEEN CRATER ELEGANTE AND CERRO COLORADO, MEXICO

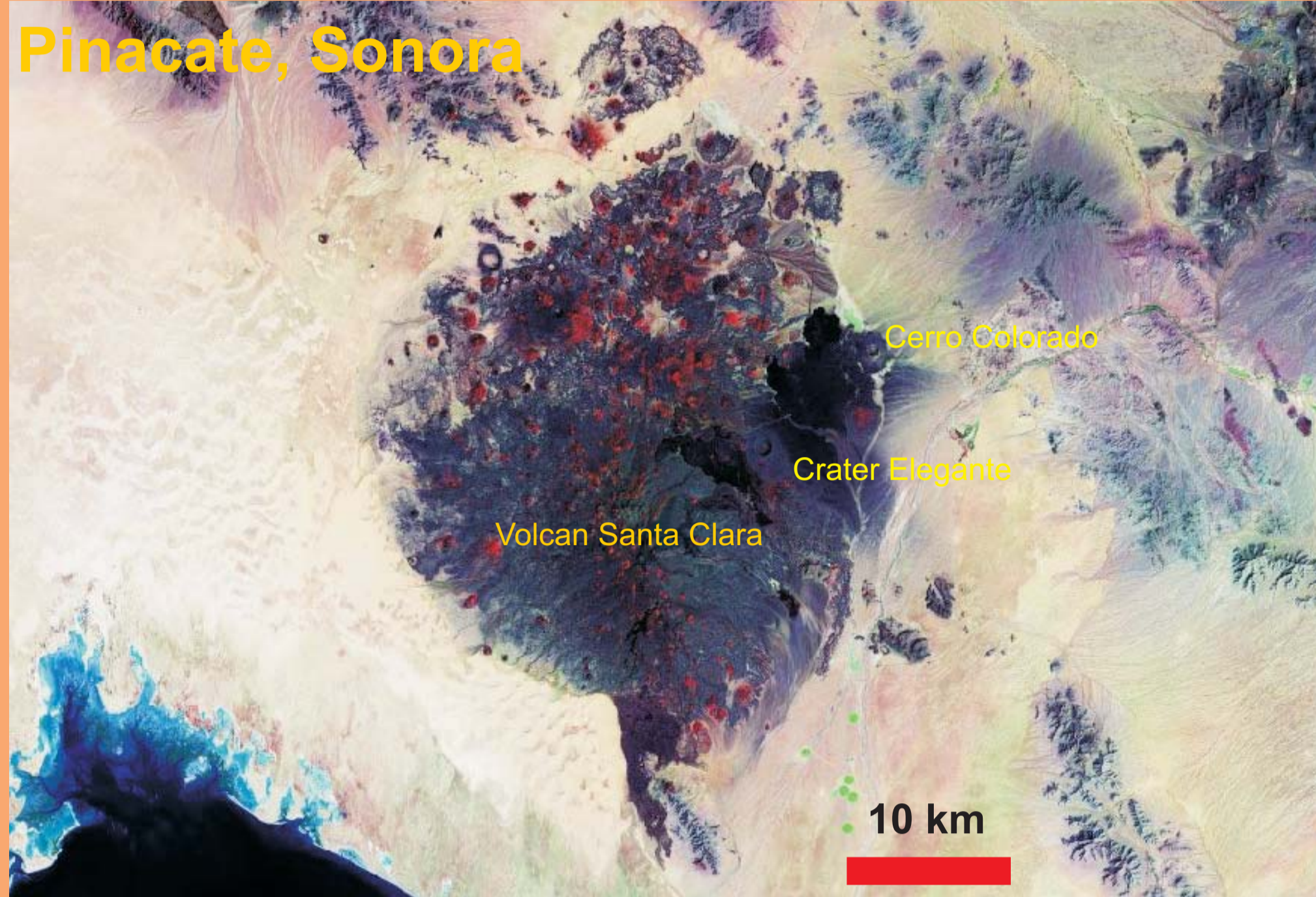
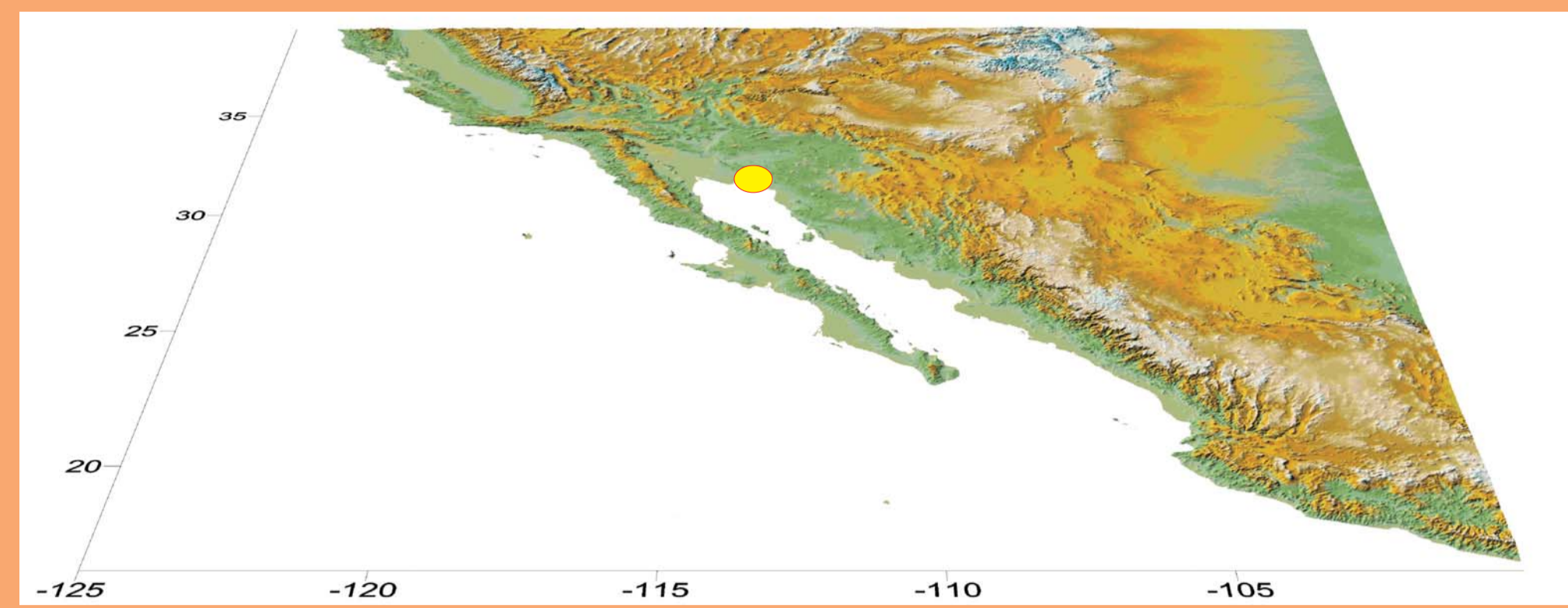
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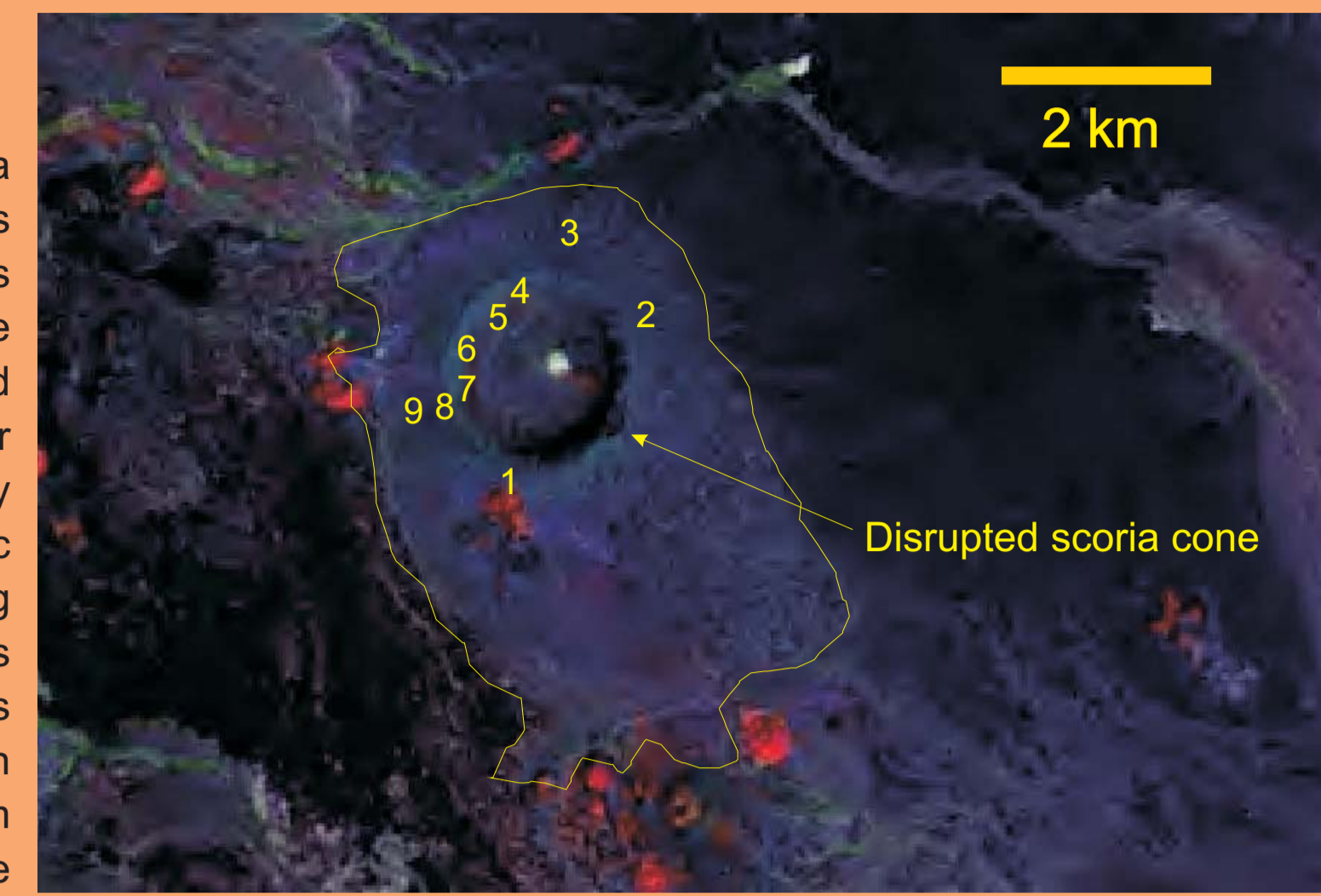
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Abstract

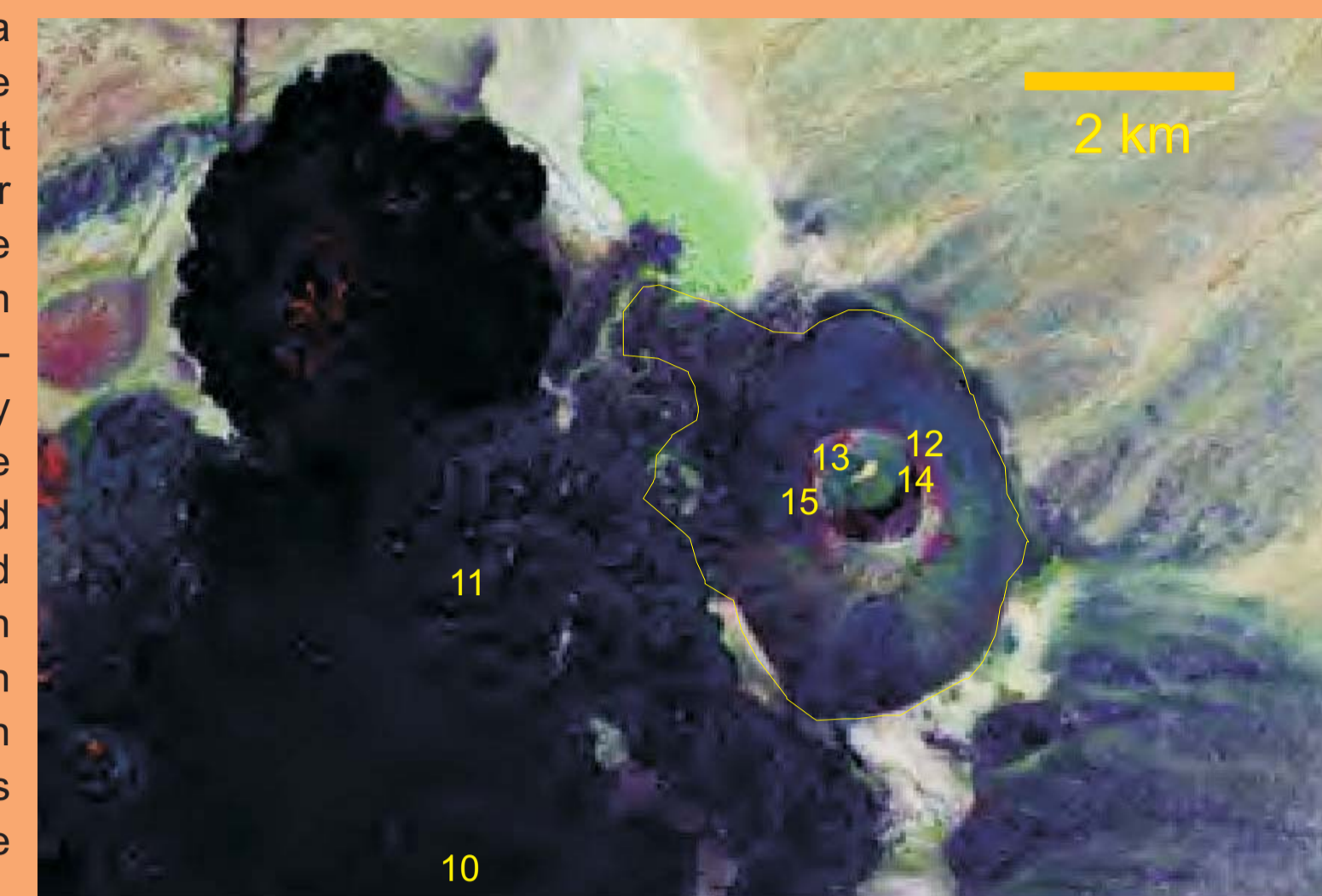
The Pinacate Volcanic Field is located just near the northern end of the Gulf of California (Sea of Cortez) in Sonora, Mexico. Extensive lava flows cover an area similar to 2000 km² which is cut through by more than 400 vents, predominantly scoria cones. Eight of the vents are maars that erupted immediately after emplacement of pre-maar lava flows, which are exposed in the crater wall. Two of the phreatomagmatic vents are especially spectacular by their size and volume, and their contrasting architecture; Crater Elegante and Cerro Colorado. Crater Elegante is about 1600 m across with a crater that is about 250 m deep, which is surrounded by a few tens of metres complete crater rim. Its age is inferred to be 0.15 Ma, and its pyroclastic deposits are dispersed more than a km away from the crater rim. They form a gentle sloping blanket over pre-maar lava flows exhibiting plastering effect over obstacles such as pressure ridges and lava blisters of the pre-maar lavas. Pyroclastic units are predominantly lapilli tuffs that are rich in fine silt, sand and angular, non-vesicular sideromelane glass shards tephritic in composition. The fine lapilli tuff and tuff units about a few hundred metres away from the rim are especially rich in angular quartz fragments that are loosely packed. Scour fills in the pyroclastic succession are calcite cemented. There is a notable trend in a quick reduction in the volume of large volcanic accidental lithic fragments derived from the various pre-maar lava flows in the lapilli tuffs from the crater rim toward distal areas. Bedding characteristics of the pyroclastic succession are predominantly massive to well bedded in near-vertical settings that quickly change to dune bedded successions with dunes having a few dm amplitude over metres wavelength. These are characteristics of deposition from sudden blast triggered base surges. The Cerro Colorado is just ~8-km to the NE from Crater Elegante and forms a ~100 m positive volcanic landform. The crater floor is just a few tens of metres below the inferred syn-volcanic surface and forms a ~600-m wide, flat depression. The crater inner wall is mantled by collapsed blocks of tuff breccia and lapilli tuff that feed small reworked volcanoclastic fans. The pyroclastic succession of Cerro Colorado is significantly coarser grained, and thicker bedded than the Crater Elegante succession. Lapilli tuffs and tuffs are rich in amoeboid shaped moderately-to-highly vesicular sideromelane lapilli and coarse ash tephritic in composition that are rimmed by gel palagonite. Intact gravel/pebble of mud and/or silt are the main accidental lithic fragments. The distinct differences in size, vesicularity, shape and alteration effect of the sideromelane shards, the ratio between juvenile to accidental lithic fragments reflect the difference of the depth of fragmentation and/or source of water interacted with the magma.



Crater Elegante



Numbers refer to the location where the photos were taken. Yellow line shows the extend of the tephra of the Crater Elegante.

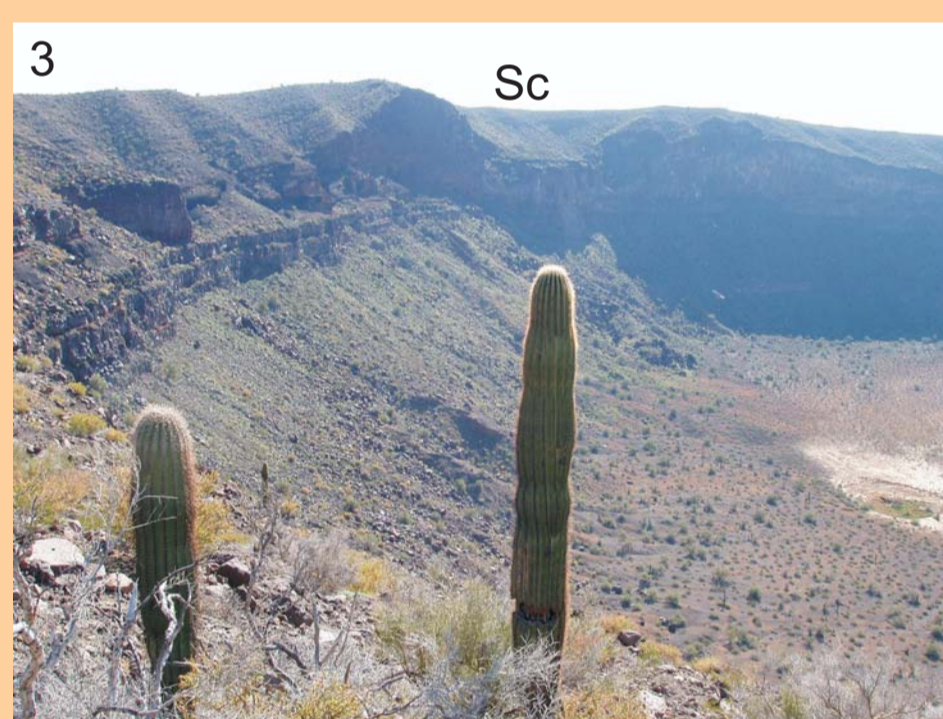
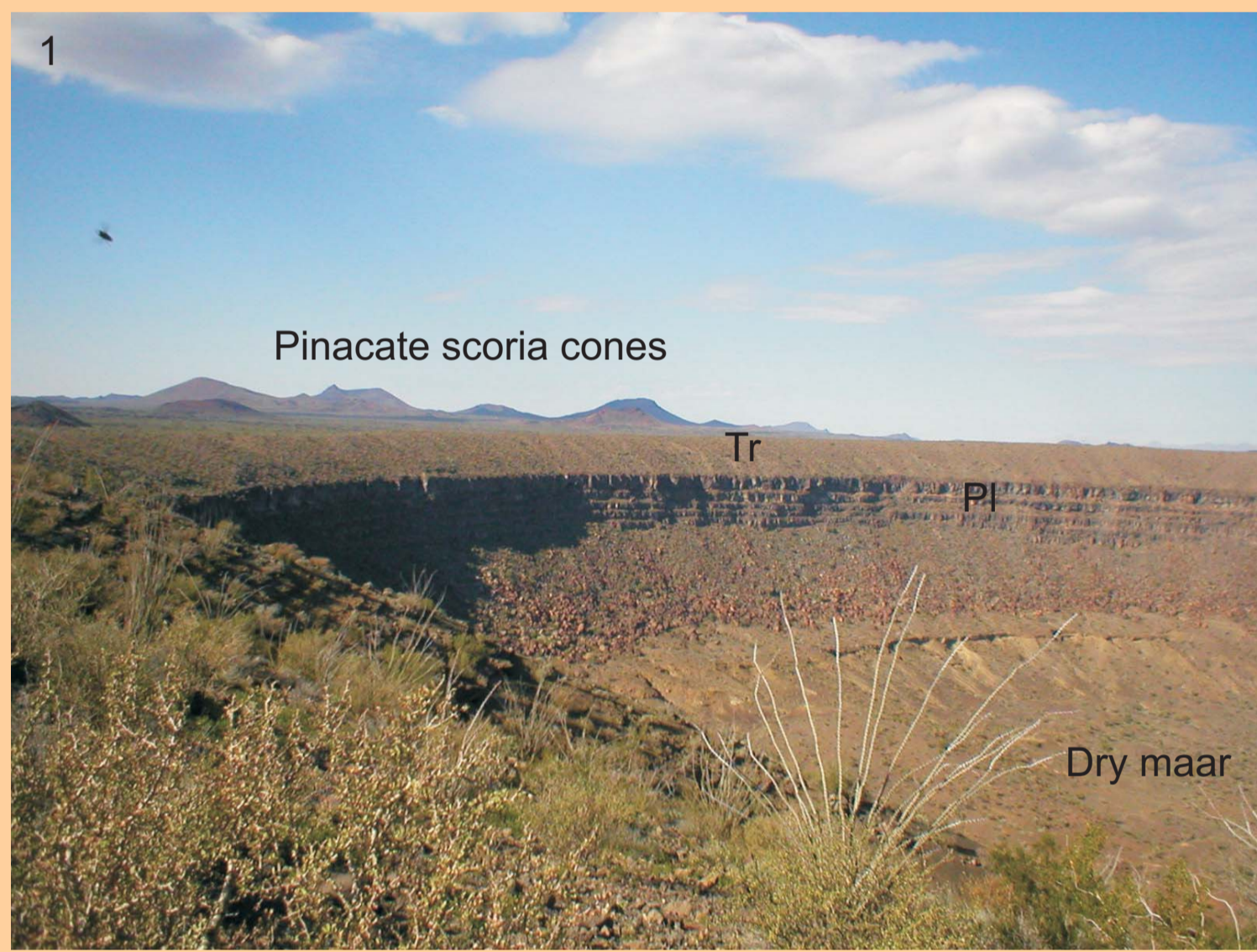


Cerro Colorado

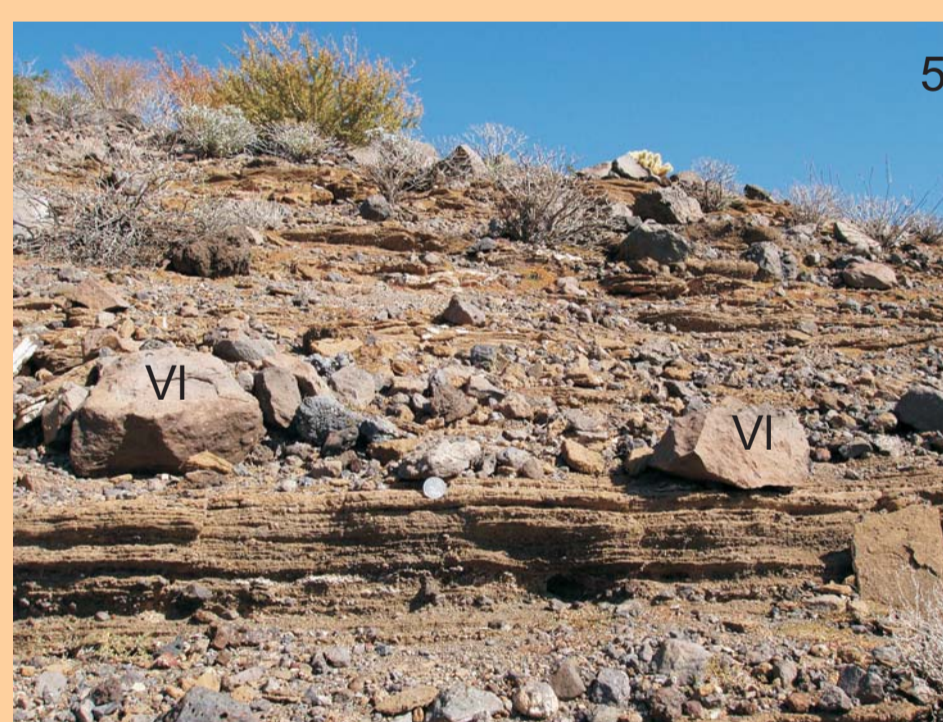


Numbers refer to the location where the photos were taken. Yellow line shows the extend of the tephra of the Cerro Colorado.

Volcan Crater Elegante



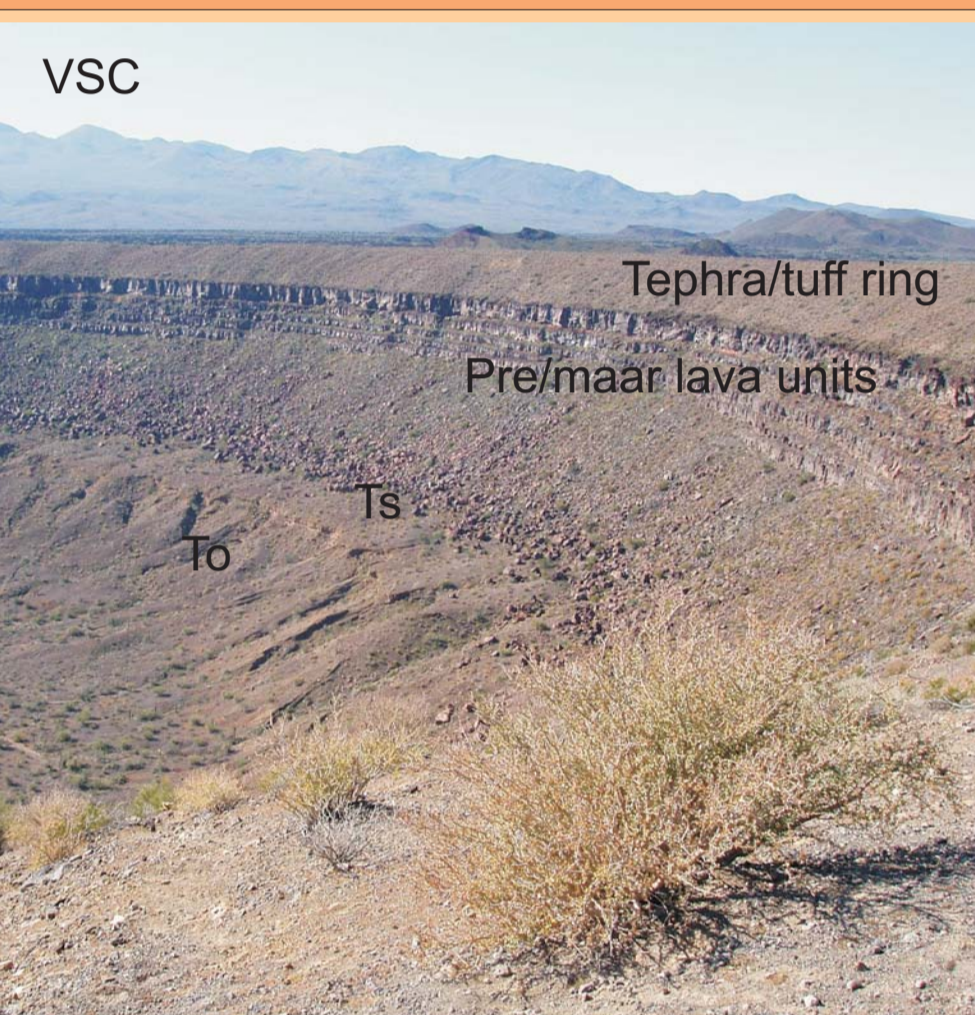
↑ The Crater Elegante maar basin from southwest. Note the pre-maar lava units (Pl) and the gentle sloping tephra ring (Tr) over Disrupted scoria cone (Sc) in the eastern rim of the Crater Elegante. Note the playa sediments in the crater floor.



↑ Volcanic lithic clast-rich lapilli tuff succession (base surge) near the western crater rim of the Crater Elegante. Volcanic lithics (VI) are derived from the pre-maar lava units.



↑ Matrix supported, channel-filling lapilli tuff bed with an antidune (arrow) bed set in the western crater rim of the Crater Elegante. This section has no accretionray lapilli but armoured lapilli are common.



Crater Elegante maar from the north rim. Volcan Santa Clara shield volcano is in the background (VSC). Note the inner depression in the maar basin (B). The platform is inferred to be either a top set of a delta front (Ts) over a toe set (To) or base surge succession simultaneously deposited with the crater floor subsidence.



↑ Calcite-cemented volcanic lithic lapilli-rich pyroclastic bombs (Pb) in fines enriched lapilli tuff bed from a near vent pyroclastic succession of the Crater Elegante.



Facies changes of base surge beds with increasing distance from the crater centre

Volcan Cerro Colorado



Assymmetric cone with wide crater of the Cerro Colorado. Note the black, scoriaceous lapilli tuff below the yellow, purely phreatomagmatic tuff, lapilli tuff



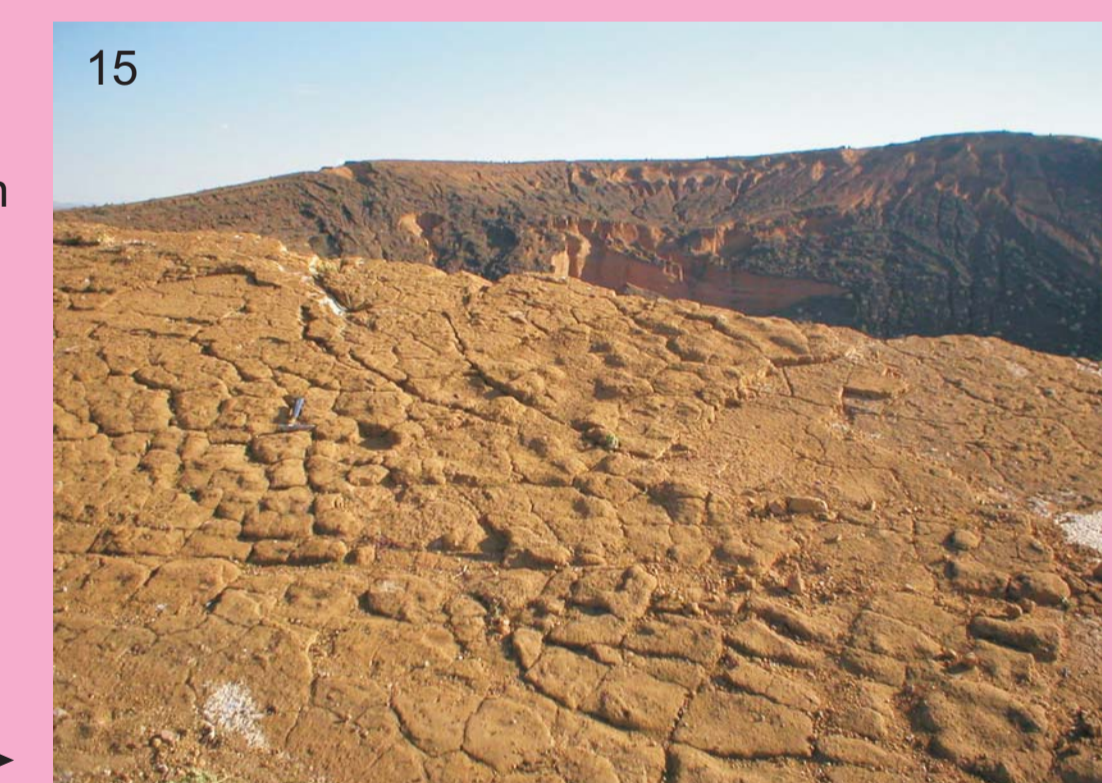
↑ Cerro Colorado from the distance. Note the erosional ravines filled with post-depositional mud flow deposits. Massive slumped lapilli tuff bed units (arrow) in the inner crater wall of Cerro Colorado. Note the small playa (P) in the crater floor and the volcanoclastic fan fed from the slumped block (F).



↑ Coarse-fine lapilli tuff unit deposited from base surge clouds. Vesiculated tuff and armoured lapilli suggest condensed water in the base surge clouds.

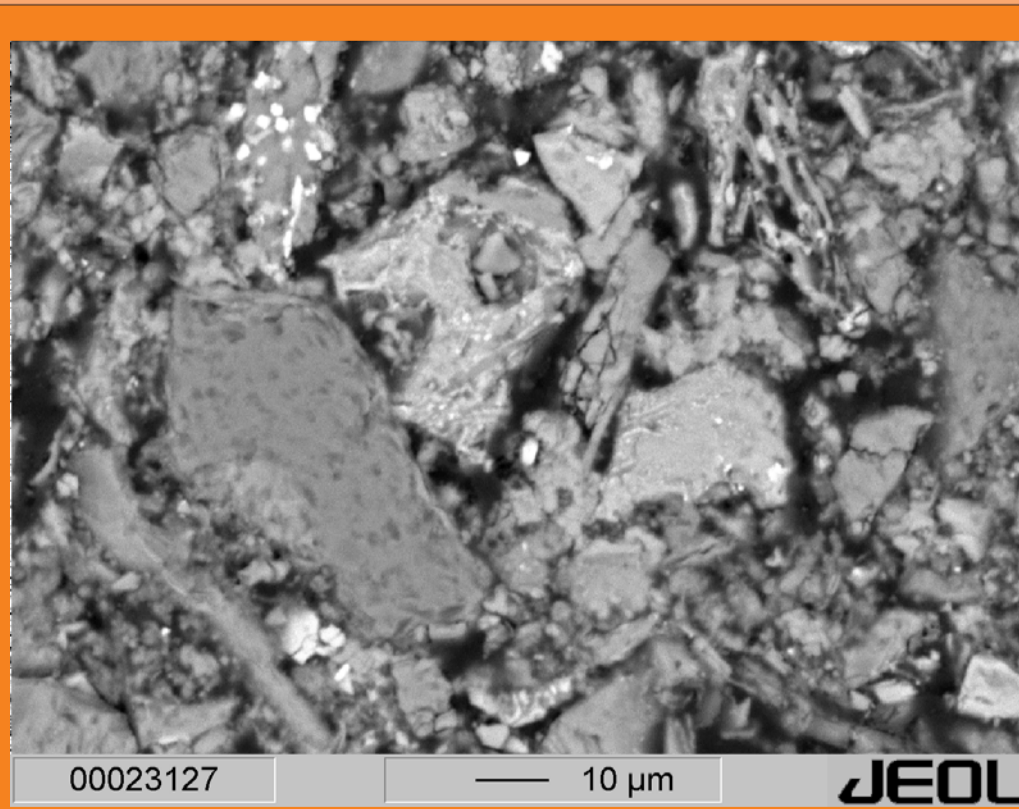


↑ Massive, weakly stratified lapilli tuff in the crater wall of the Cerro Colorado. The crater floor is about 25 m below the syn-eruptive morphology.

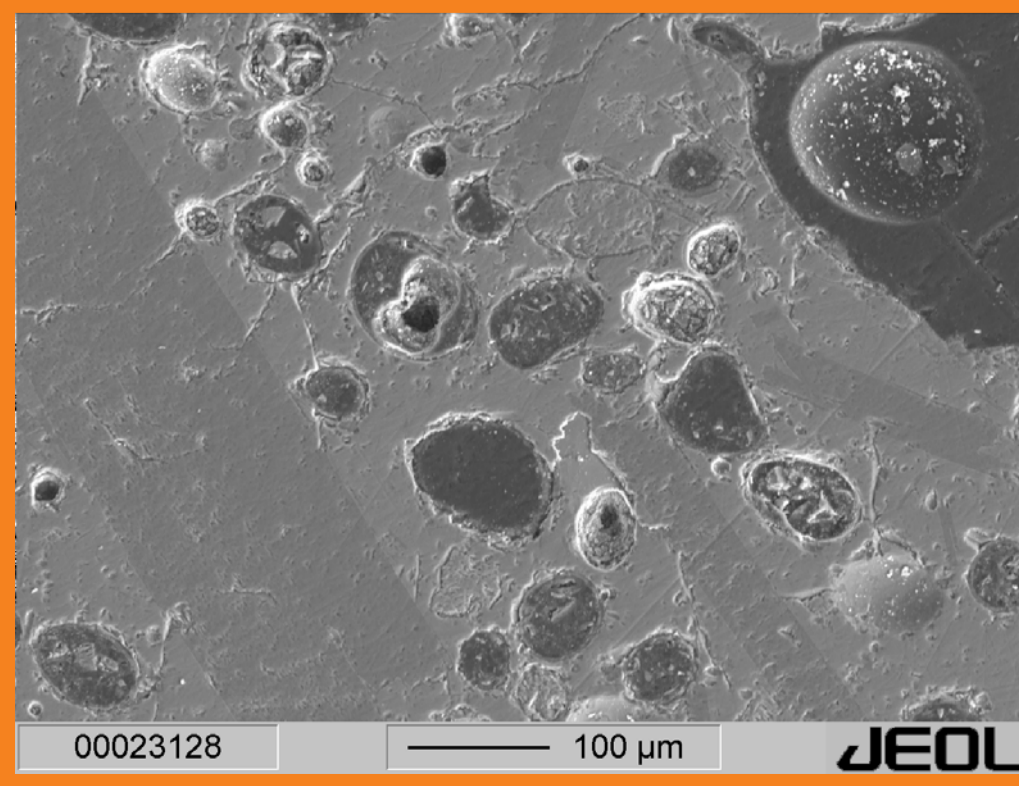


↑ Mudcracks on the surface of a vesiculated tuff unit in the western crater rim. Mudcracks suggest intensive dewatering of the tephra after deposition.

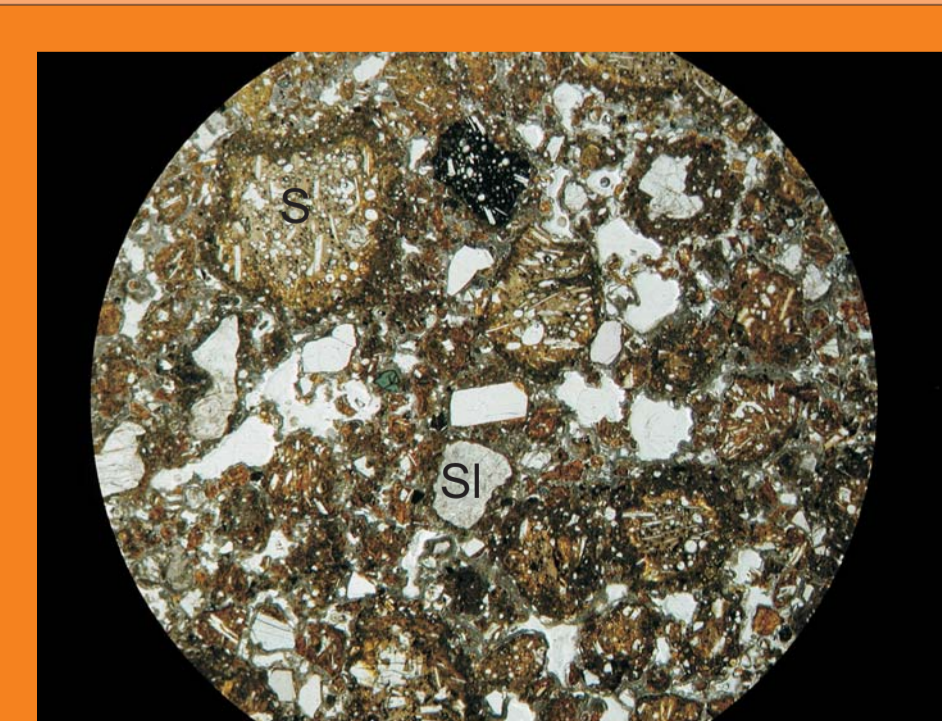
Microtextures



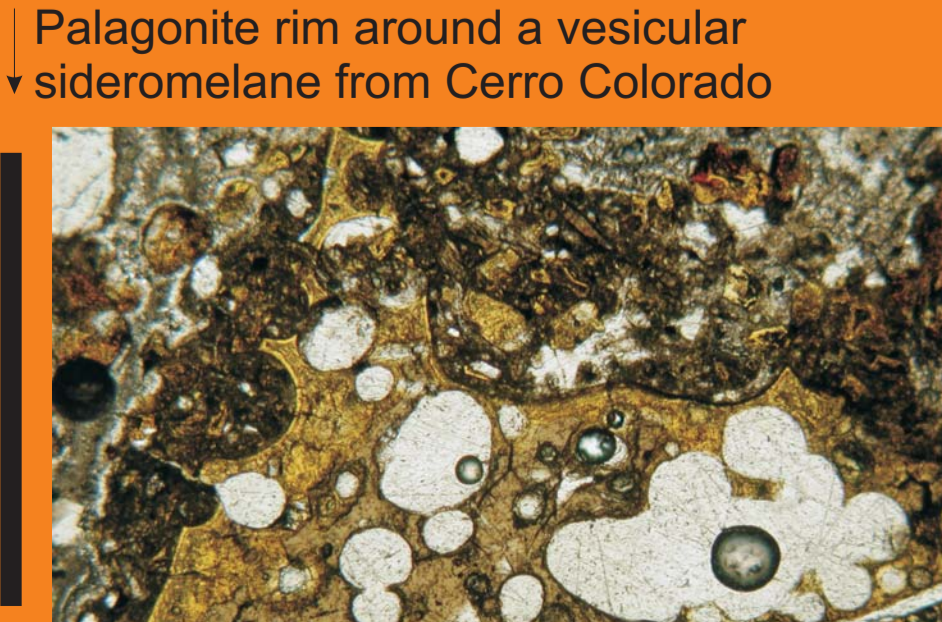
↑ SEM photo of a lapilli tuff from the Crater Elegante. Note the bright coloured sedimentary fragments and the loose packing of the rock (empty voids are black fields).



↑ SEM photo of a sideromelane glass shard from a lapilli tuff from the Cerro Colorado. Note the rounded vesicles in the otherwise blocky glass shard.

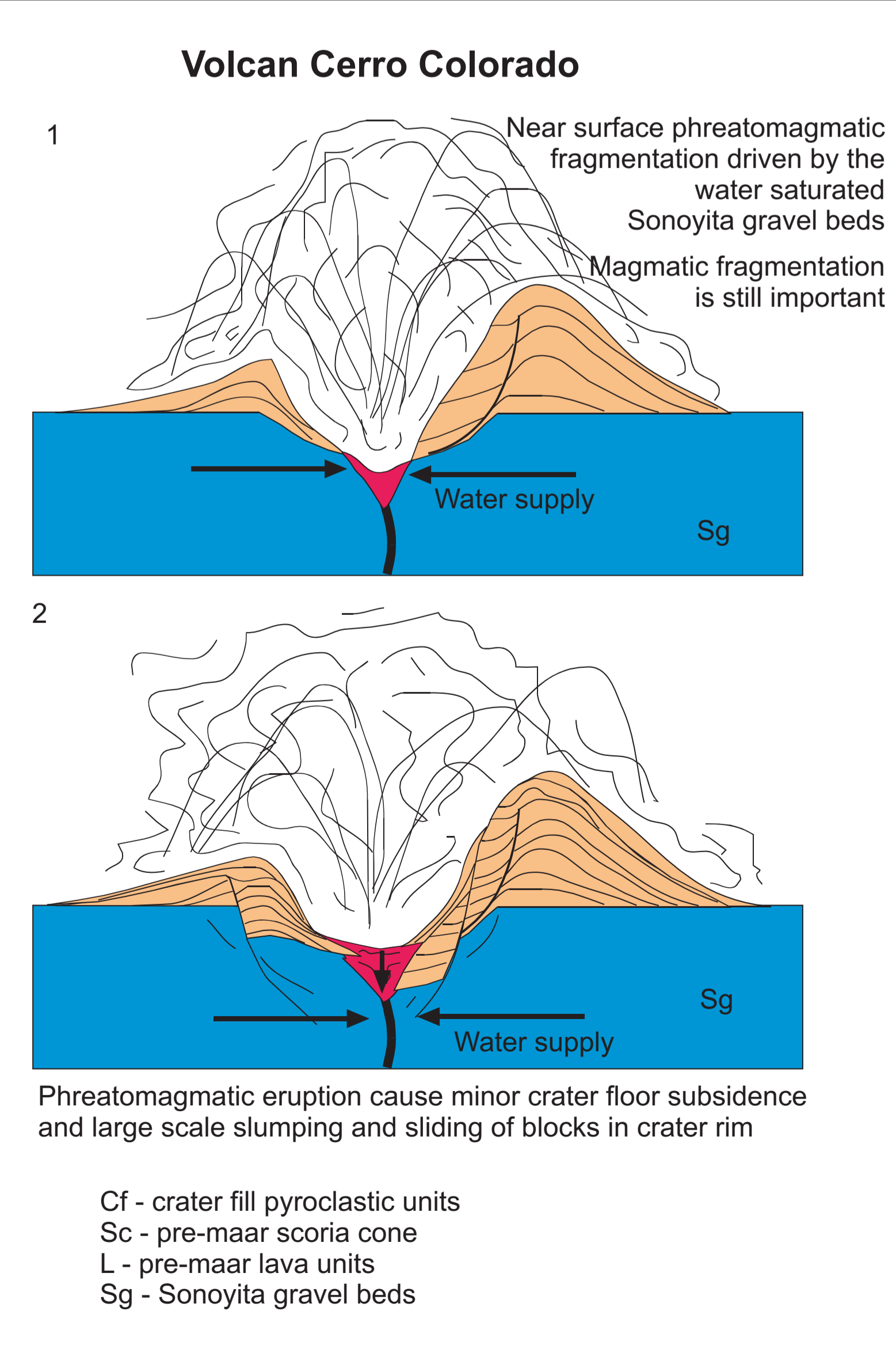
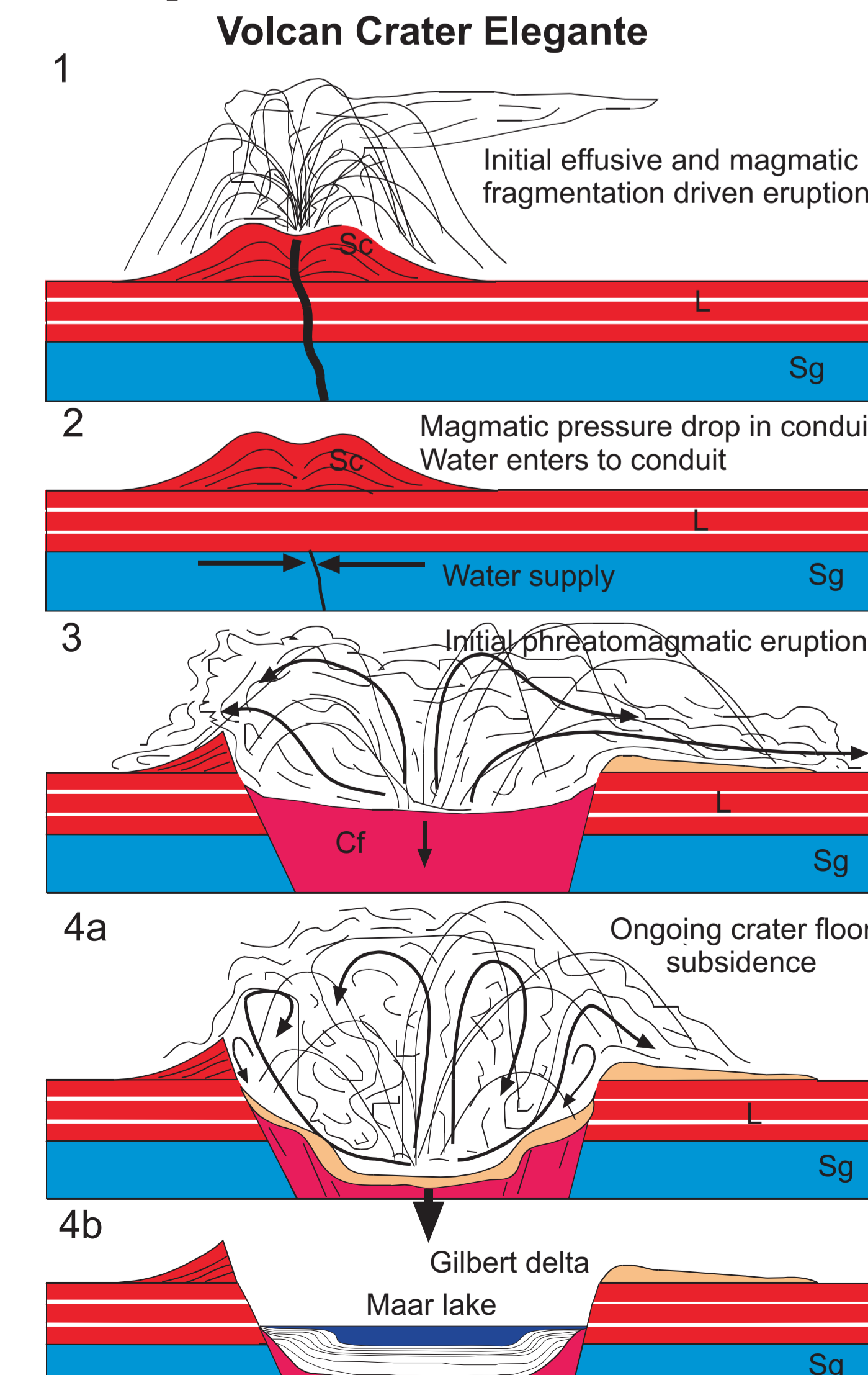


↑ Photomicrograph of a lapilli tuff from the Cerro Colorado. Note the bright coloured sedimentary lithics (Sl) and the microlite-rich sideromelane (S).



↑ Palagonite rim around a vesicular sideromelane from Cerro Colorado

Eruptive mechanism



Phreatomagmatic eruption cause minor crater floor subsidence and large scale slumping and sliding of blocks in crater rim

Cf - crater fill pyroclastic units
Sc - pre-maar scoria cone
L - pre-maar lava units
Sg - Sonoyita gravel beds

Electron microprobe analyses on volcanic glass shards from Pinacate

	SiO ₂	Al ₂ O ₃	TiO ₂	FeO	MnO	MgO	CaO	Na ₂ O	K ₂ O	Na ₂ O+K ₂ O	Total
Cerro Colorado	50.55	13.32	3.24	14.17	0.14	2.93	10.18	2.89	1.99	4.88	100
Crater Elegante	46.23	12.51	4.46	16.1	0.14	3.19	12.28	3.04	1.36	4.4	100
Crater Elegante	51.77	14.53	3.43	11.36	0.15	1.8	11.72	3.31	1.52	4.63	100

Eruptive mechanism of phreatomagmatic volcanoes from the Pinacate Volcanic Field: comparison between Crater Elegante and Cerro Colorado, Mexico.

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