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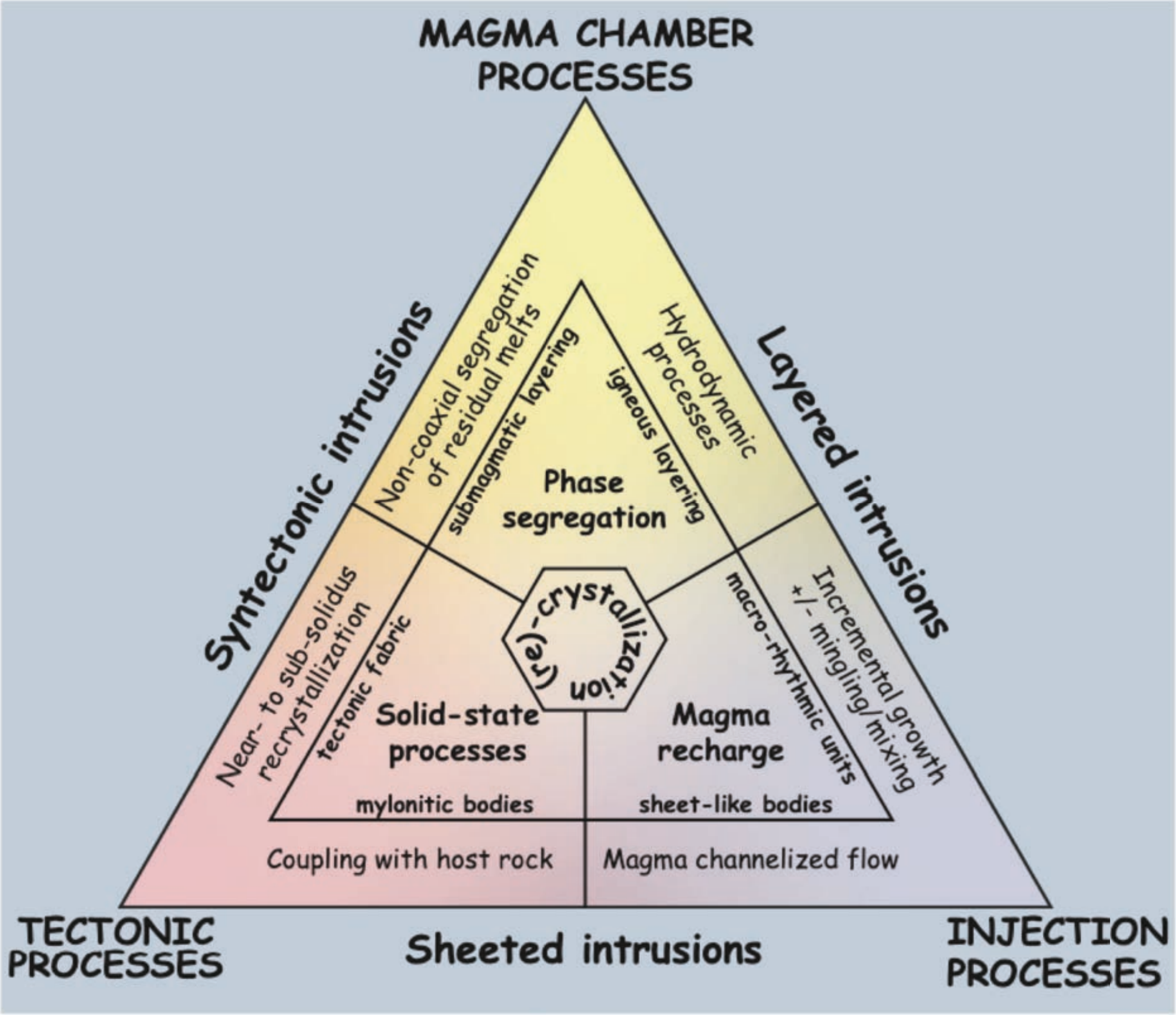
Le micro- e le macro-strutture che le caratterizzano si formano dal contributo dei processi sia magmatici che tettonici. Queste strutture possono essere determinate tramite le relazioni di campo, la petrografia, la geochimica e la geologia strutturale.



Barbey (2009; Geol Belg)

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Vediamo qualche esempio di strutture legate a processi magmatici

Barbey (2009; Geol Belg)

Barbey (2009; Geol Belg)

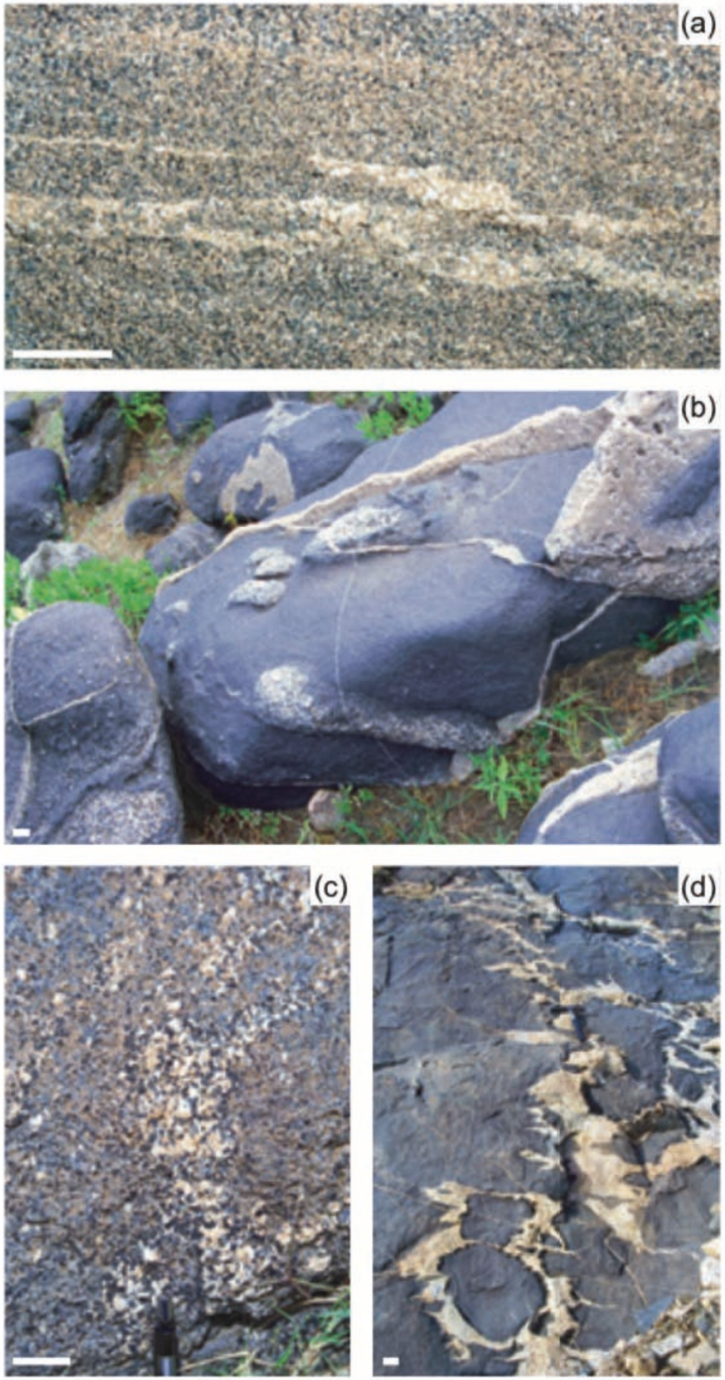


Figure 4. Granitic melt segregations in mafic-silicic layered intrusions. **(a)** Leucogranitic melt segregation layers parallel to igneous layering in granodiorite (Tarçouate pluton, Morocco; vertical cut; scale bar: 2 cm). **(b)** and **(c)** Granitic pipes and veins cutting through mafic layer (Negash pluton, Ethiopia; scale bar: 3 cm). **(d)** Mafic sheets crosscut by net-veining of differentiated granite (Tahala pluton, Morocco; plan view; scale bar: 10 cm).

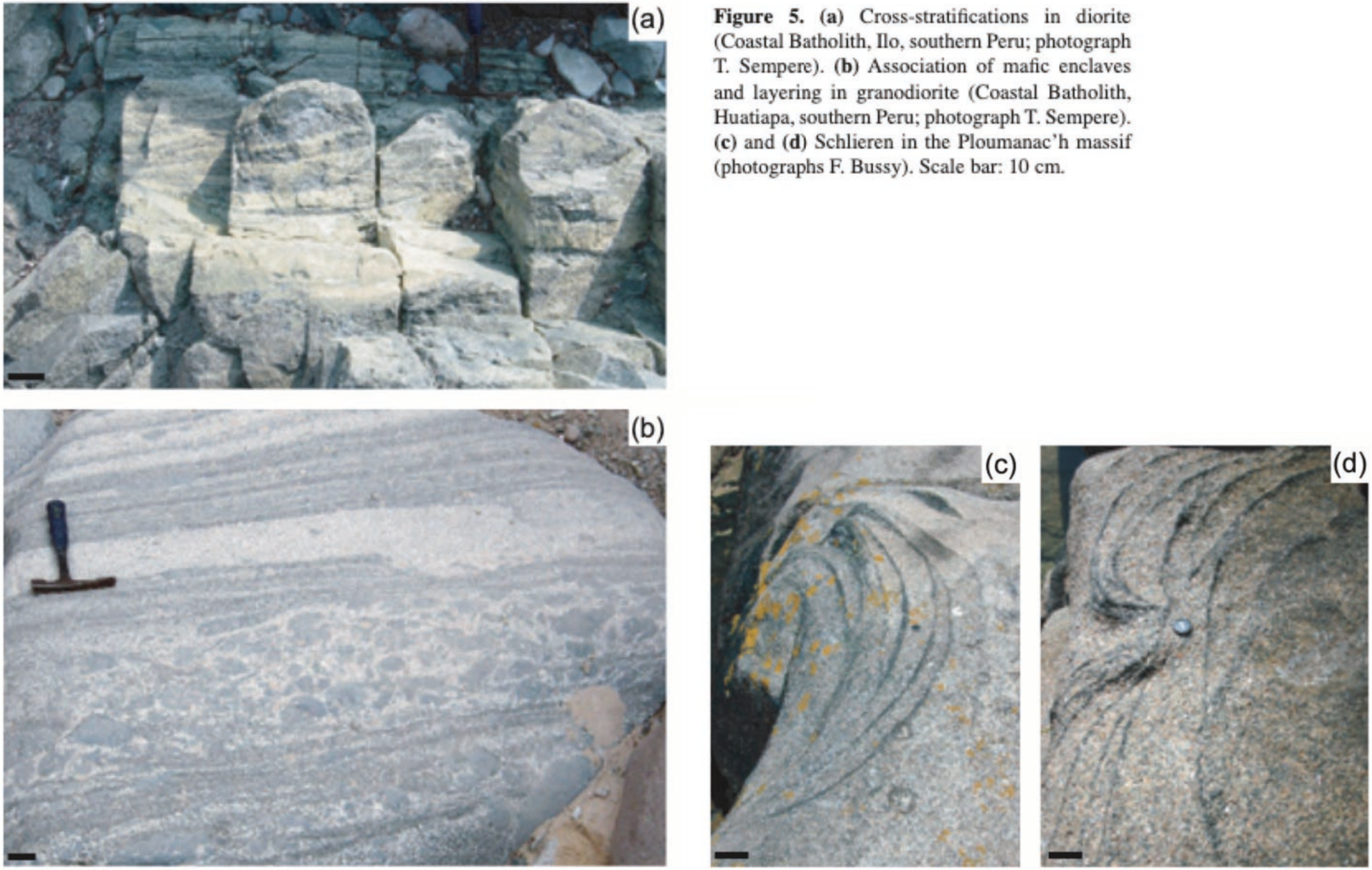


Figure 5. **(a)** Cross-stratifications in diorite (Coastal Batholith, Ilo, southern Peru; photograph T. Sempere). **(b)** Association of mafic enclaves and layering in granodiorite (Coastal Batholith, Huatiapa, southern Peru; photograph T. Sempere). **(c)** and **(d)** Schlieren in the Ploumanac'h massif (photographs F. Bussy). Scale bar: 10 cm.

Barbey (2009; Geol Belg)

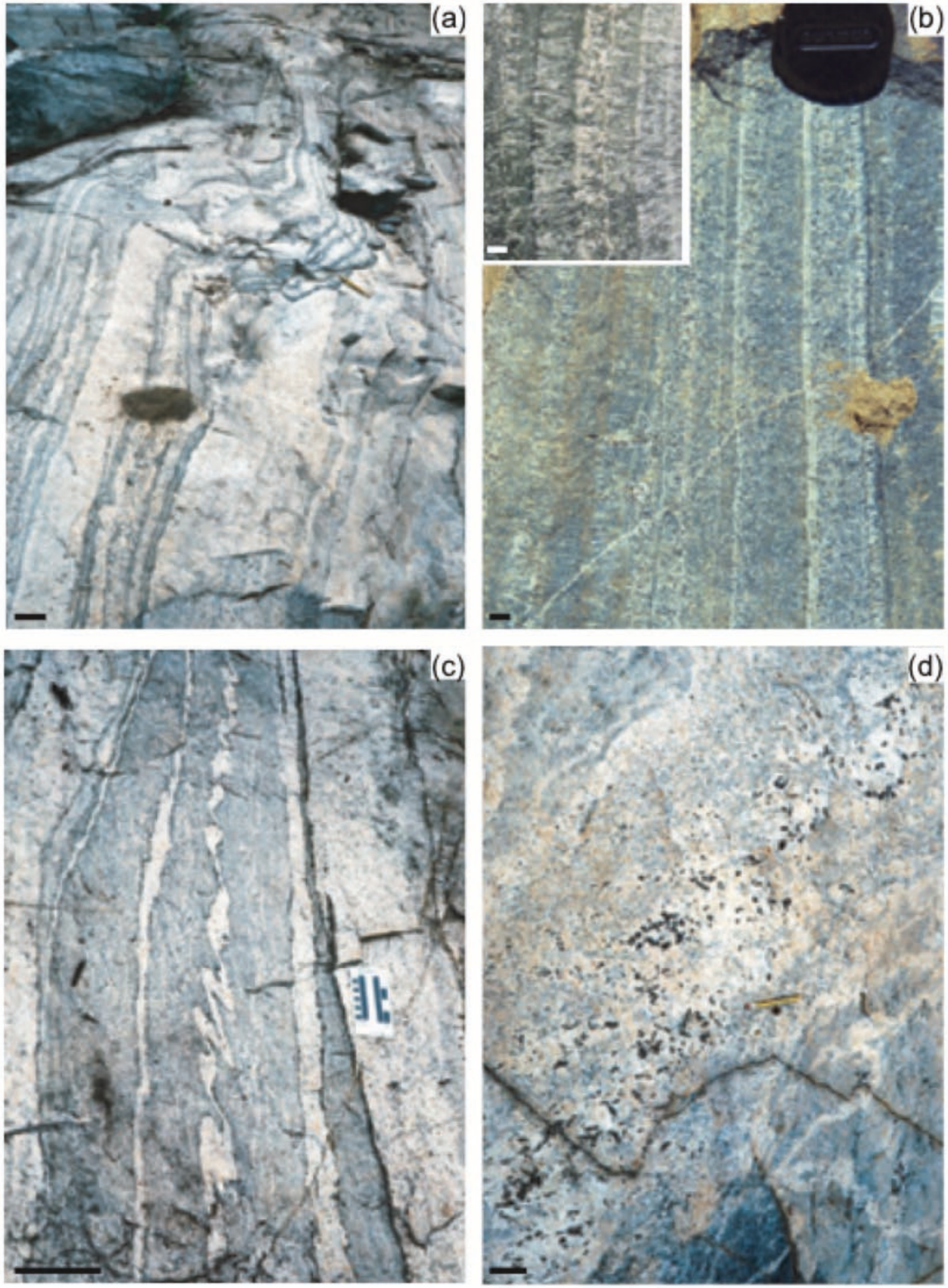


Figure 6. **(a)** Succession of paired isomodal biotite-rich and quartzofeldspathic layers. **(b)** Isomodal layering in a monzodiorite dyke associated with directional growth textures of feldspar (Tarçouate pluton, Morocco; scale bar: 1 cm). **(c)** Pegmatite veins parallel to the rhythmic layering; note the variable thickness of the veins and their distinct states of deformation indicating diachronic emplacement. **(d)**. Diffuse pegmatite patches delineating a loose layering structure. [(a), (c) and (d) Estrela Granite Complex, Carajàs Province, Brazil; scale bar = 10 cm].

Barbey (2009; Geol Belg)

Vinalhaven Intrusive Complex

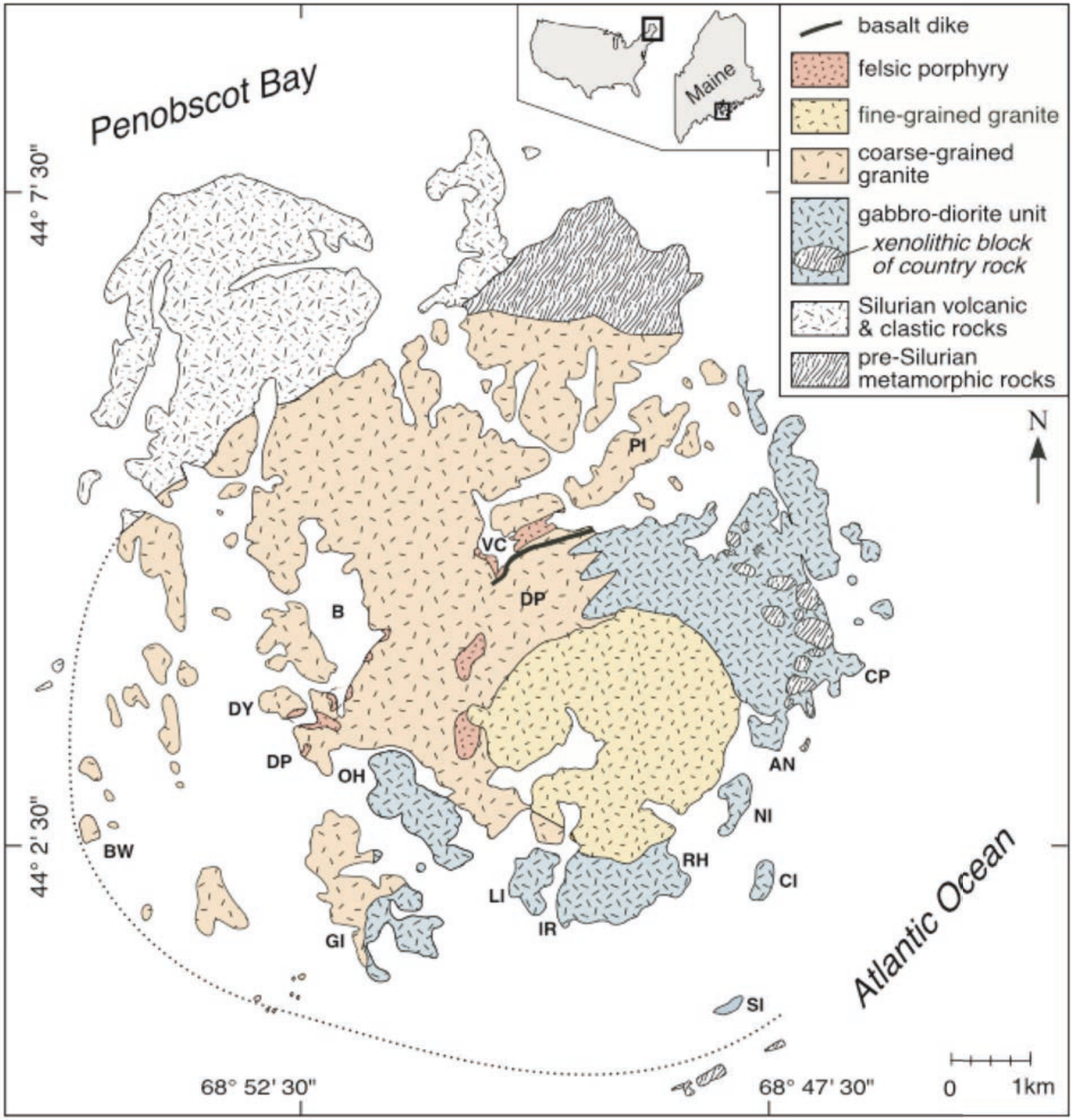


Fig. 1. Geological map of Vinalhaven Island. Pre-Silurian rocks exposed along the NE margin of the VIC are strongly foliated metamorphic rocks of the Calderwood Formation. Silurian, mostly unfoliated, rocks exposed along the coast include siliciclastic rocks of the Seal Cove Formation and volcanic and volcaniclastic rocks of the Vinalhaven rhyolite. Locations mentioned in the text: AN, Arey Neck; B, The Basin; BW, Big White Island; CI, Carvers Island; CN, Coombs Neck; CP, Calderwood Point; DP, Dog Point; DY, Dyer Island; GI, Greens Island; IR, Indian River; LI, Lanes Island; NI, Narrows Island; OH, Old Harbor; PI, Penobscot Island; RH, Roberts Harbor; SI, Sheep Island; VC, Vinal Cove. Modified after Gates (2001).

Wiebe & Hawkins (2012; J Pet)

Vinalhaven Intrusive Complex

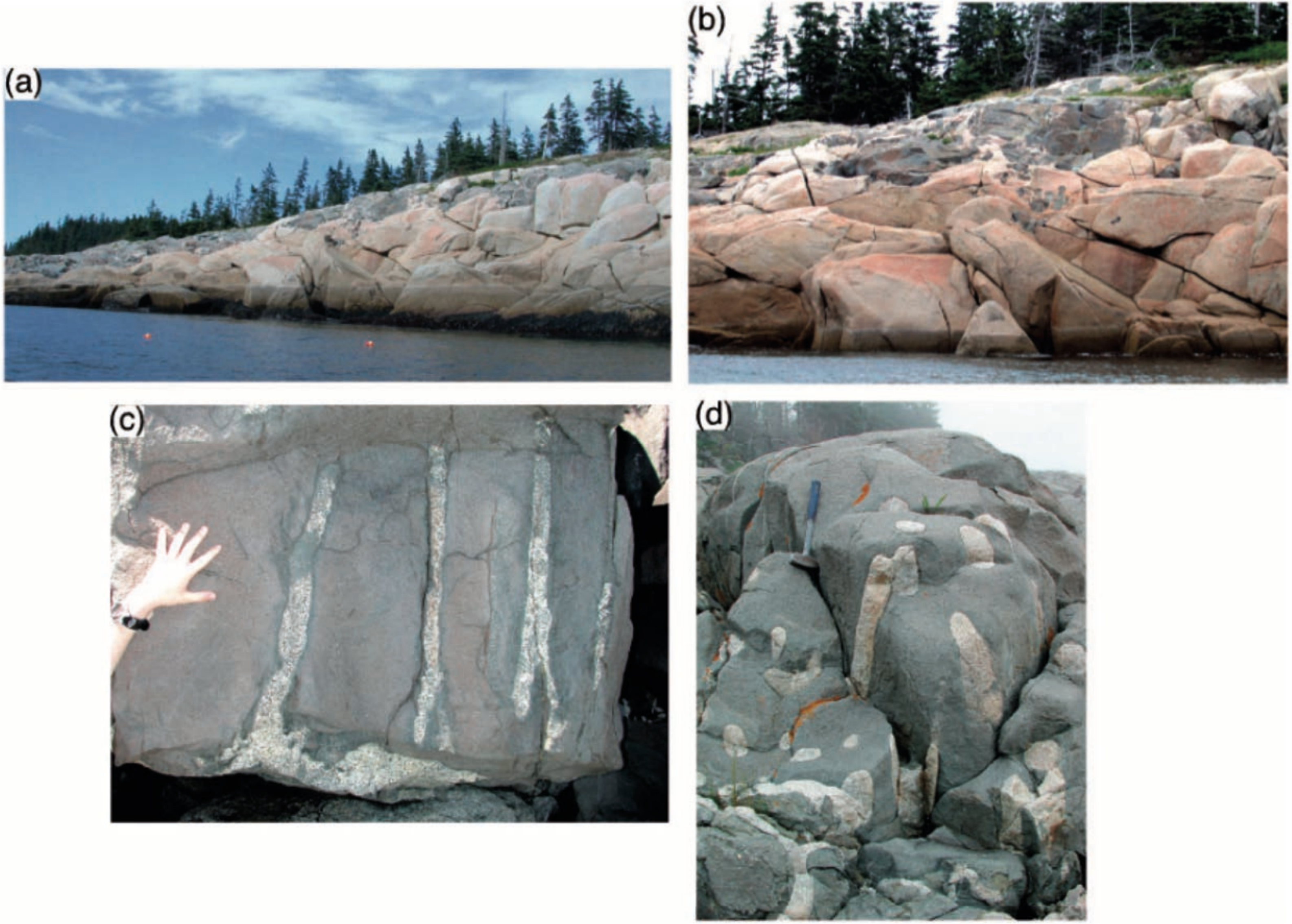


Fig. 3. Field photographs of granitic diapiric bodies cutting the bases of macrorhythmic layers. (a) Distant view of base of gabbroic layer resting on coarse-grained granite. (b) Close-up view of the same contact, showing diapiric upwellings of granite extending more than 10 m upward into the gabbroic layer. (c) Thin felsic pipes connected to felsic top of underlying macrorhythmic layer. (d) Three-dimensional exposures of a cluster of coarse-grained granitic pipes in gabbro on Greens Island.

Wiebe & Hawkins (2012; J Pet)

Vinalhaven Intrusive Complex

Wiebe & Hawkins (2012; J Pet)

Fig. 6. Field photograph of a pillow mound from Old Harbor area (Fig. 1).

Vinalhaven Intrusive Complex

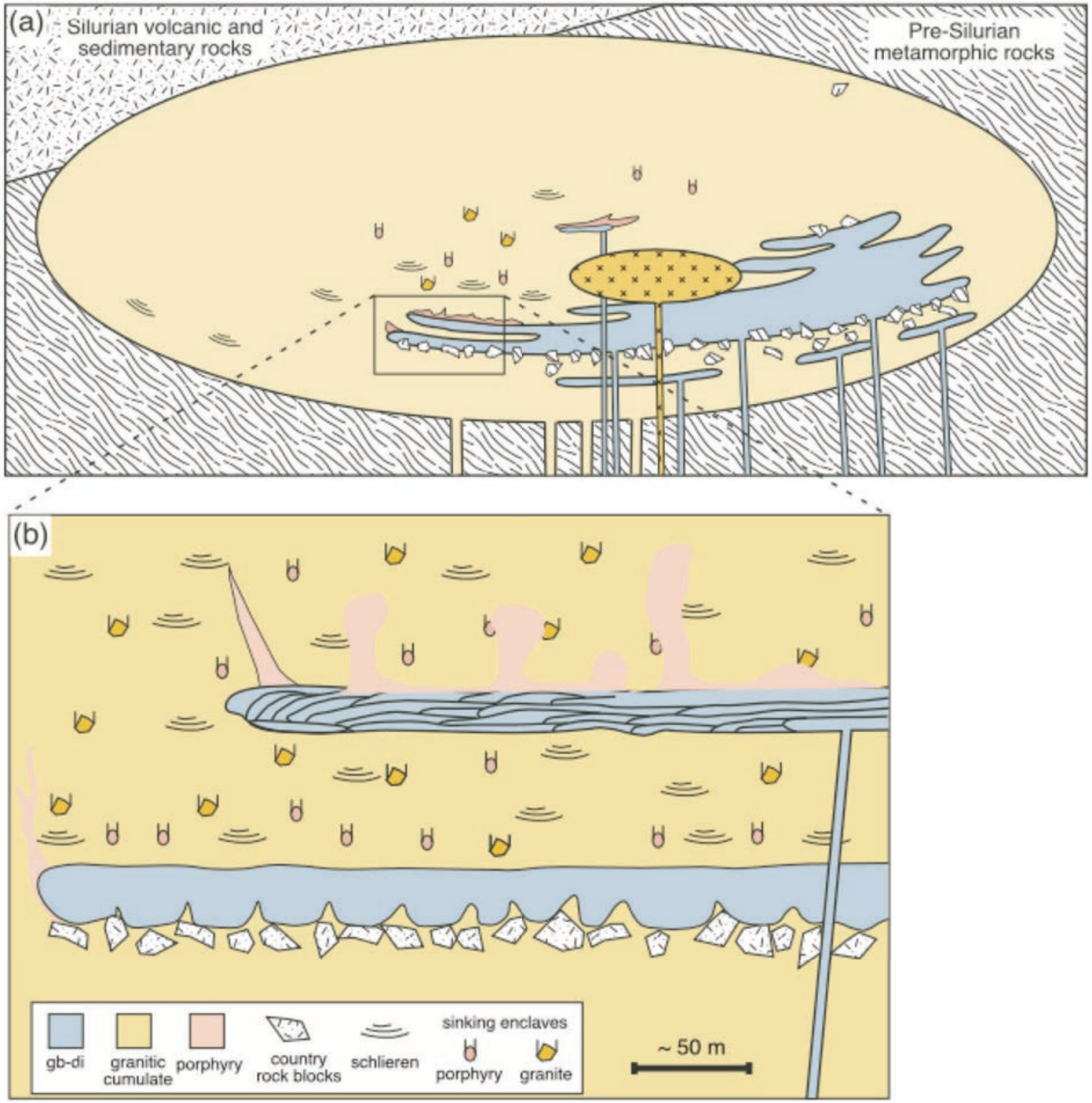


Fig. 16. (a) Schematic east–west oblique slice through the exposed part of the VIC (essentially the map viewed looking northward down the dip of the mafic sheets). It should be noted that the lower margin of the granite is not the base of the plutonic rocks, but only the southern margin of the exposed pluton. Mafic enclaves in granite below the exposed mafic rocks, gravity data and recycled zircons with ages that extend back to the age of volcanic rocks cut by the pluton roof (Hawkins *et al.*, 2009) require that a substantial volume of pluton must exist at greater depth. (b) Cross-section through the western terminations of the two gabbrodiorite sheets located at the southern end of Greens Island and at Old Harbor (GI and OH in Fig. 1). Gb-di, gabbrodiorite. (See text for details.)

Wiebe & Hawkins (2012; J Pet)

Vediamo l’esempio del batolite di Tuolumne (Sierra Nevada)

(tratto da Paterson et al. 2009)

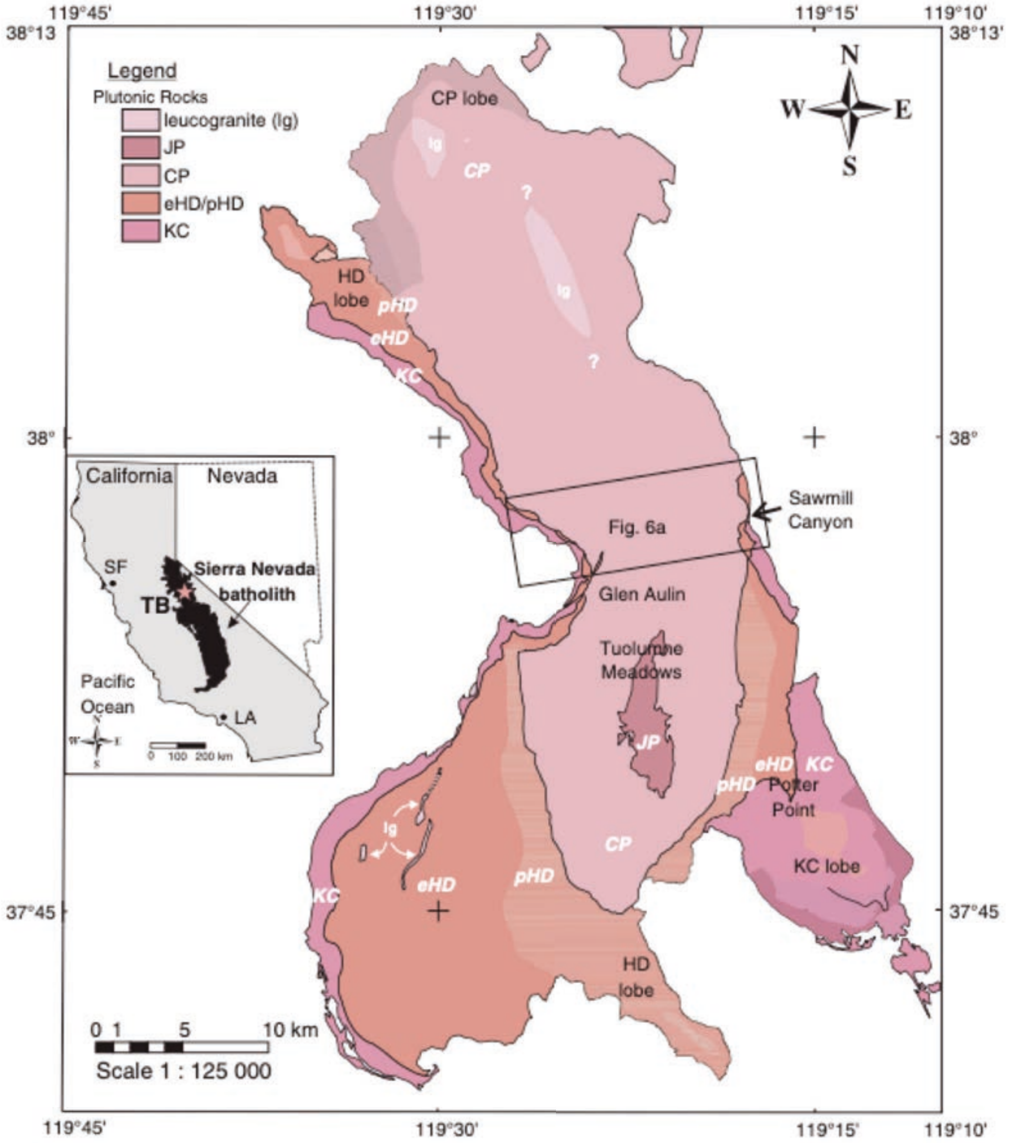


Figure 1. Geologic map of Tuolumne batholith and its host rocks (after Huber et al., 1989). Includes new mapping (by Paterson and colleagues) of much of the batholith at a scale of 1:24,000. Note the five main units in the central batholith and presence of additional internal zoning in the four lobes extending out from the units in the central batholith (after mapping by Memeti and colleagues). The structures discussed in this paper occur in all units and in lobes. Index map shows location of Tuolumne batholith (TB) in California. Box indicates location of Figure 6A. KC—Kuna Crest unit; CP—Cathedral Peak granodiorite; JP—Johnson granite porphyry; HD—Half Dome granodiorite (p is porphyritic, e is equigranular); SF—San Francisco; LA—Los Angeles.

Paterson et al. (2009; Geosphere)

Schlieren (concentrazioni di materiale mafico all’interno di corpi granitici/granodioritici)

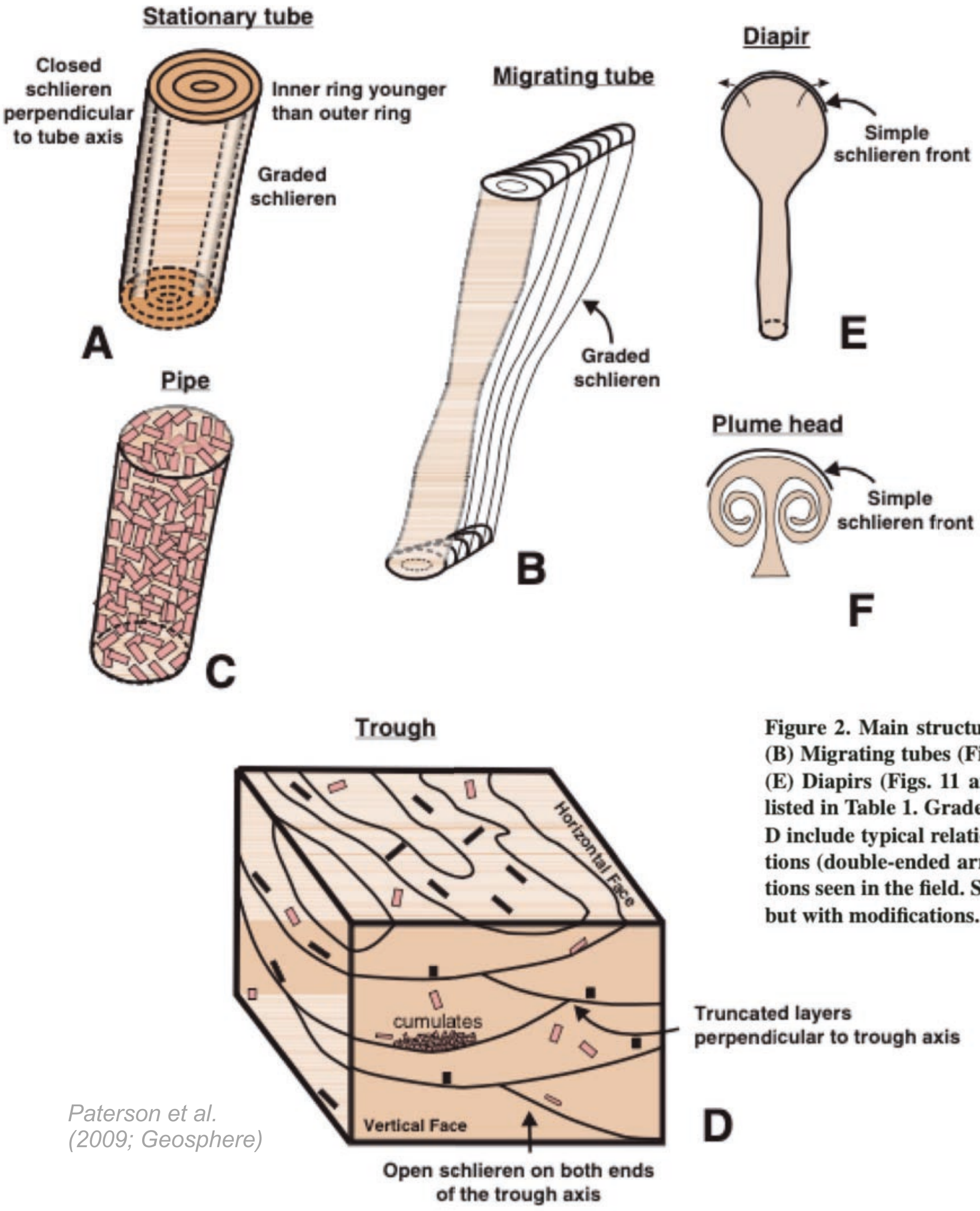


Figure 2. Main structures discussed in this paper. (A) Stationary tubes (Figs. 3 and 5A). (B) Migrating tubes (Figs. 4 and 5). (C) Pipes (Figs. 7 and 8). (D) Troughs (Figs. 9 and 10). (E) Diapirs (Figs. 11 and 12). (F) Plume heads (Fig. 13). The distinguishing features are listed in Table 1. Graded schlieren layers shown where developed in structures. Troughs in D include typical relationships between trough cutoffs, mineral fabrics, magma flow directions (double-ended arrow, as absolute flow direction is uncertain), and crystal accumulations seen in the field. Some drawings are influenced by diagrams in Weinberg et al. (2001), but with modifications.

Paterson et al. (2009; Geosphere)

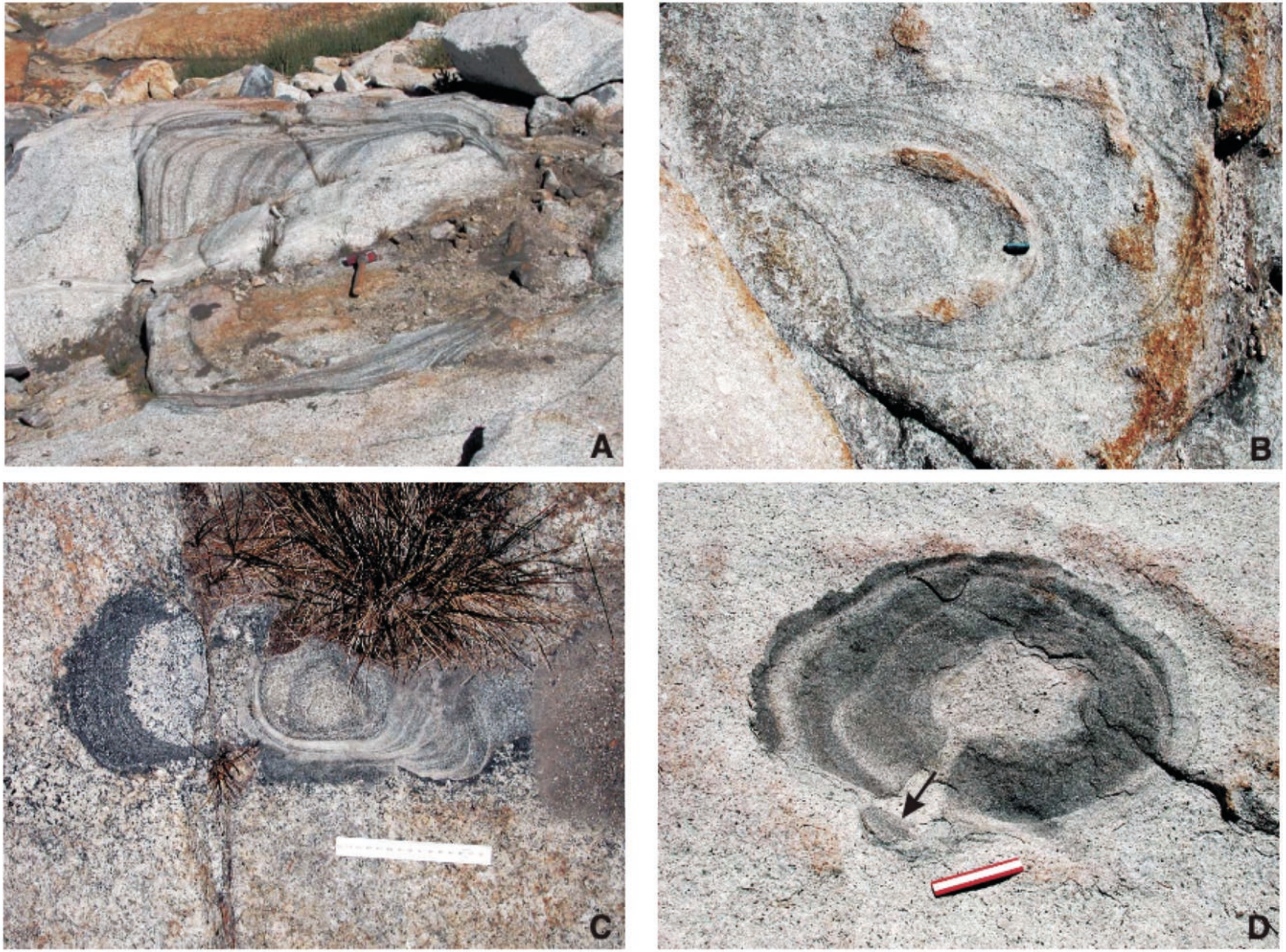
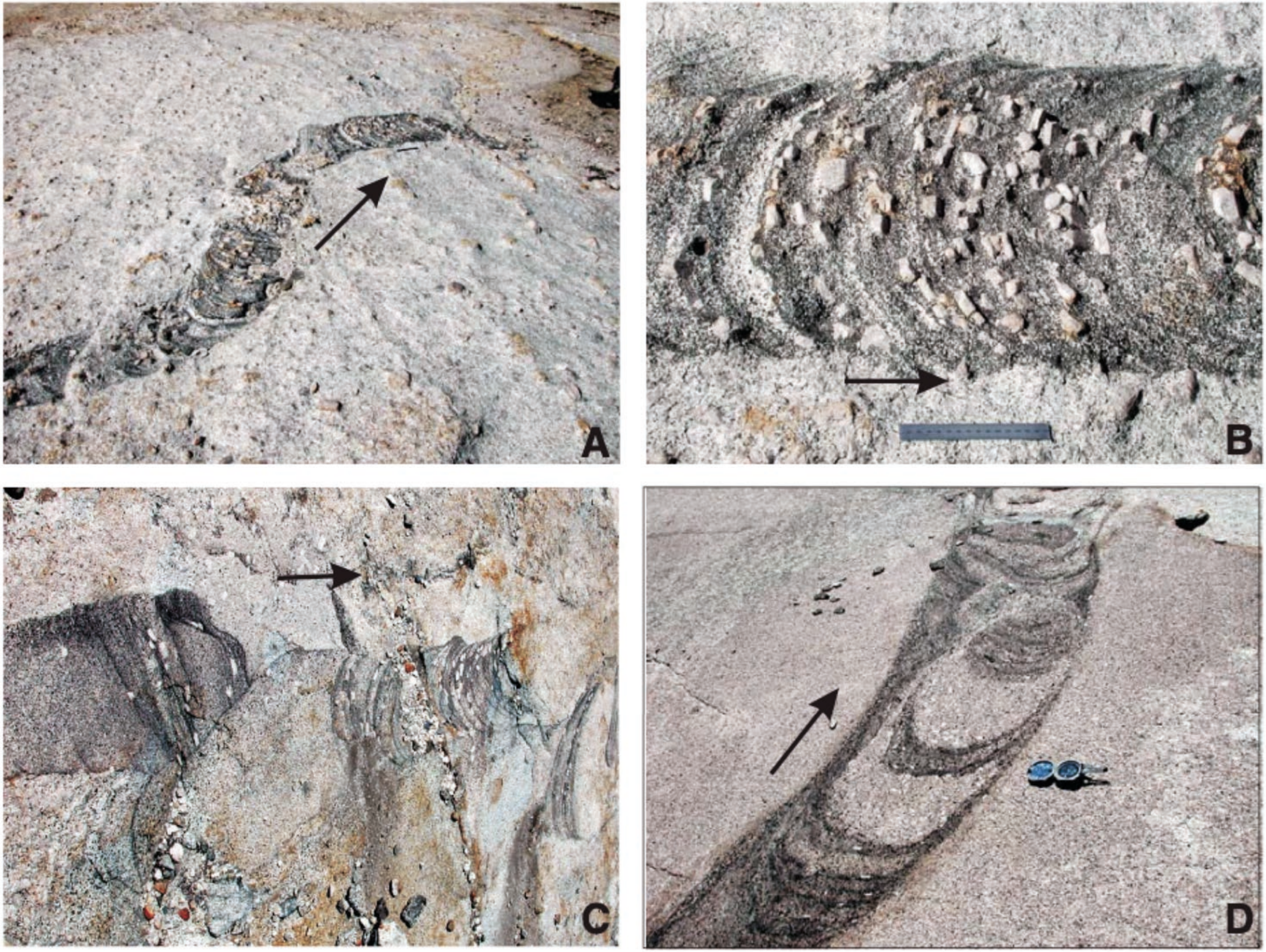


Figure 3. Photos of stationary (nonmigrating), steeply plunging tubes in the Tuolumne batholith (for other examples, see Weinberg et al., 2001; Žák and Klomínský, 2007). Crosscutting relationships between schlieren always indicate younging inward, that is, tube diameters decrease with time. (A) Equigranular Half Dome (HD) granodiorite in southern HD lobe; hammer for scale is ~25 cm. (B) Cathedral Peak granodiorite; 6.5 cm lip balm for scale. (C) HD granodiorite magmas with variable compositions and textures in Turner Lake granite host. Ruler for scale is 15 cm. (D) Mafic HD granodiorite magma in Turner Lake granite. Note how part of mafic tube margin was broken off and displaced outward (parallel to arrow) by magma from tube center. Ruler for scale is 15 cm.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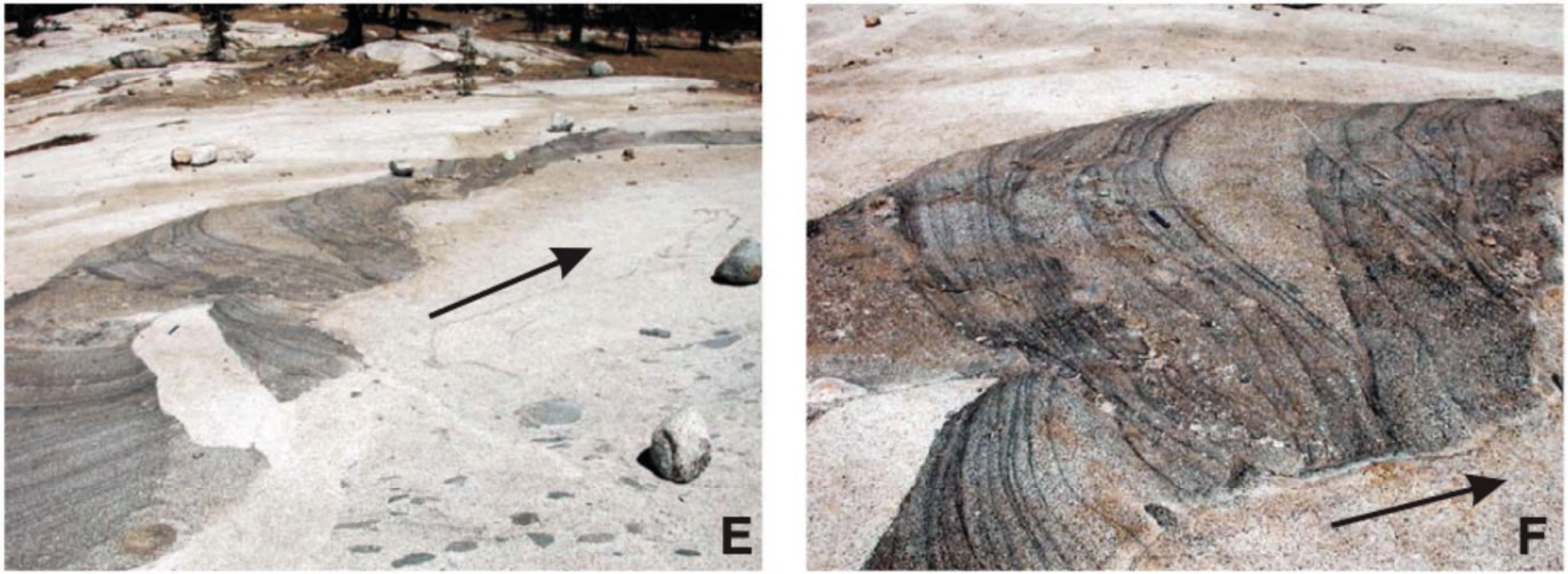


Figure 4. Photos of steeply plunging, migrating tubes in the Tuolumne batholith. Arrows show direction of migration. Ruler in photos A, B, E, and F is 15 cm. (A) Overview of migrating (southwest to northeast in photo) tube in the Cathedral Peak (CP) granodiorite; ruler near northeast end of tube for scale. (B) Close-up of one part of migrating tube shown in A. Note that the composition of felsic layers in tube are identical to host magma. (C) A row of several separate migrating tubes in the CP granodiorite. The first schlieren ring in one tube always truncates the last rings in the slightly older tube. All migrated in the same direction (left to right in photo). Some layers in tubes have K-feldspar megacrysts, others do not. Photo ~3 meter across. (D) Fairly mafic layers bounding migrating tube in the Half Dome granodiorite. Tube walls interdigitate with host magma and some rings in tube have field characteristics identical to those in the host granodiorite. Brunton compass for scale. (E) Migrating tube in transition zone between Half Dome and Kuna Crest unit granodiorites near Potter Point, Lyell Canyon. Tube is reintruded by host magma and decreases its diameter as it youngs (parallel to arrow) toward top of photo. Ruler is in region of reintrusion. (F) Close-up of one part of tube in E showing heterogeneous compositions and truncation of tube walls indicating younging (migration of) tube to right in photo (parallel to arrow).

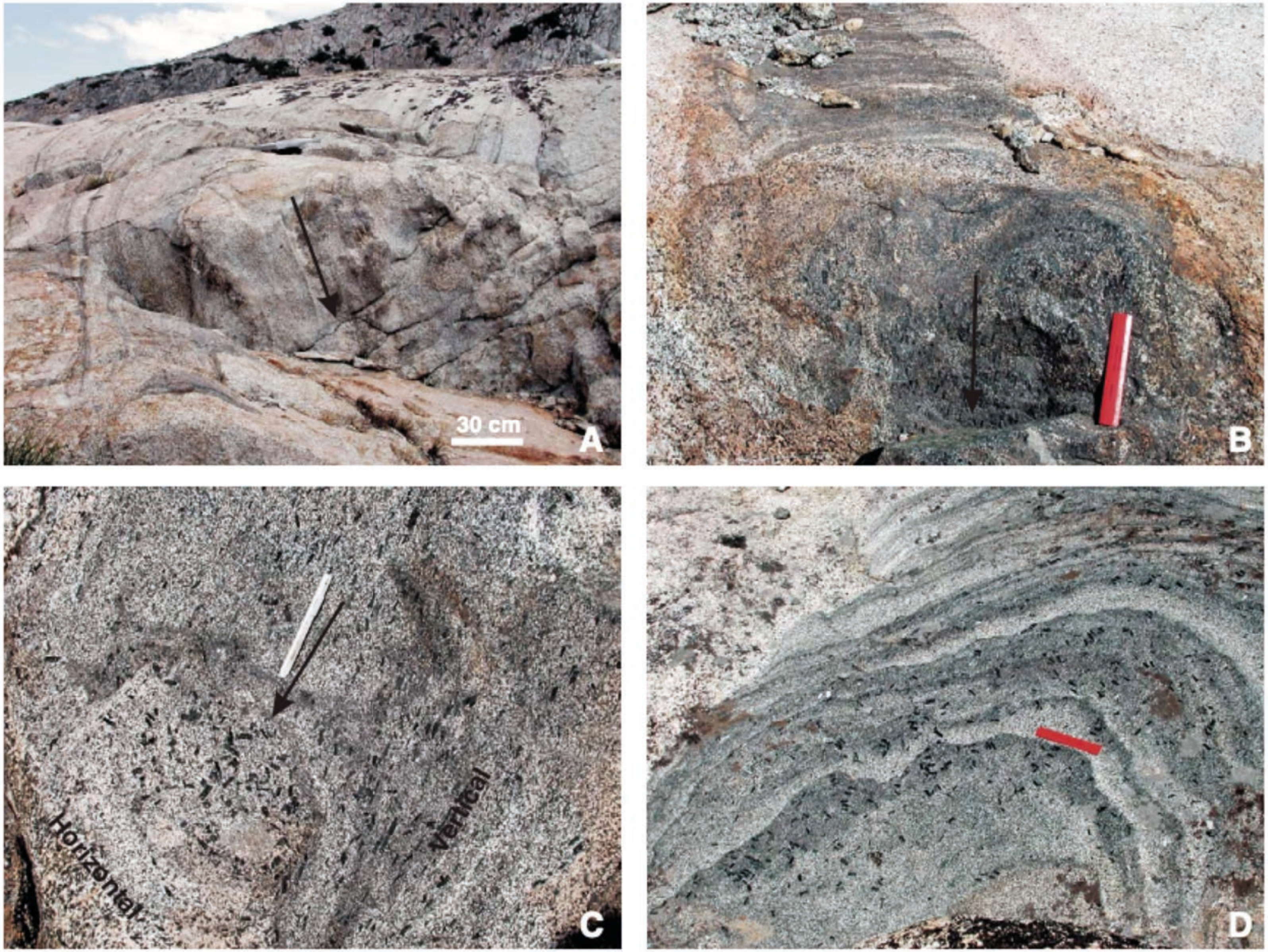
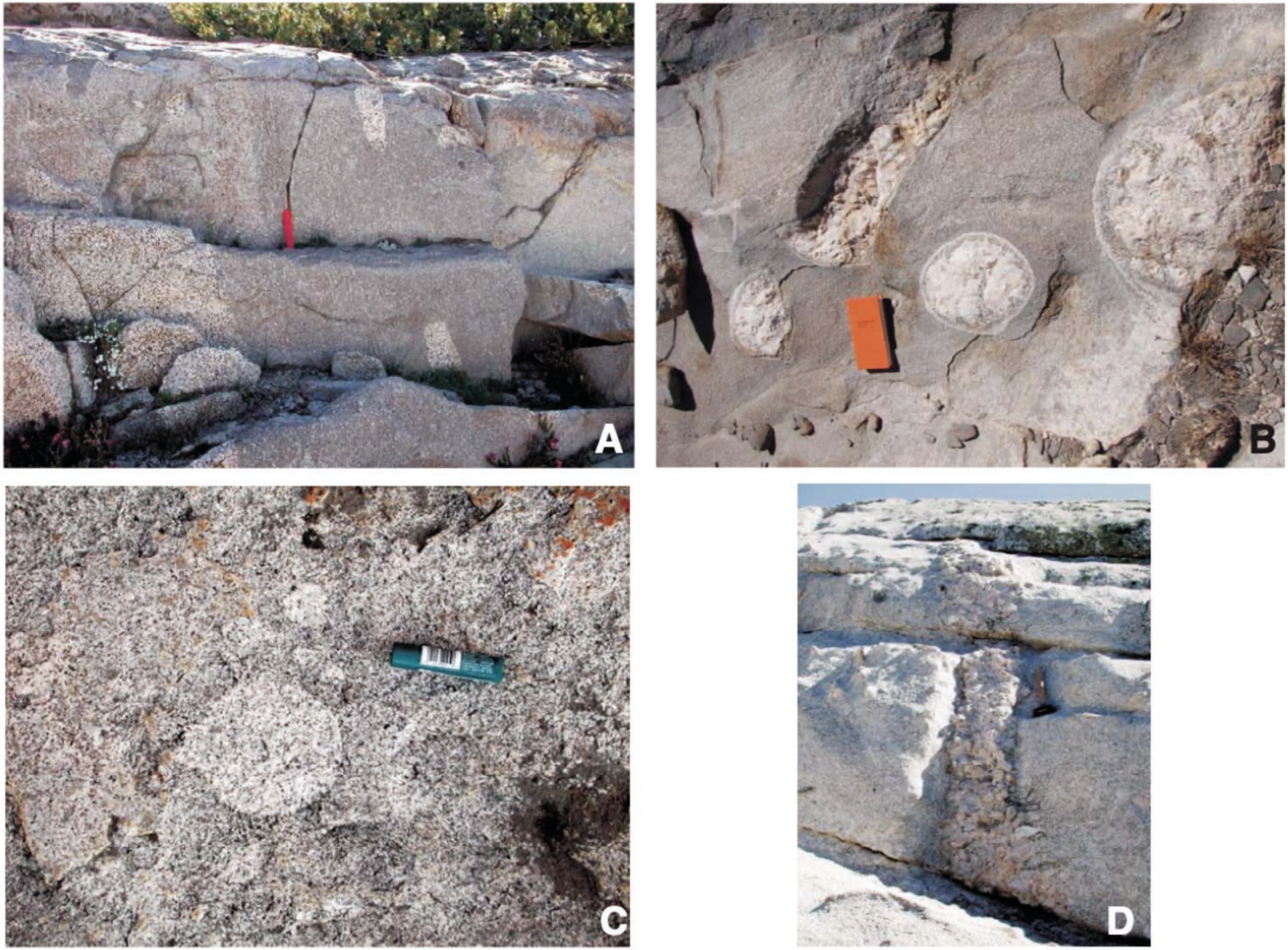


Figure 5. Three-dimensional view of tubes showing subvertical schlieren-bounded walls and steeply plunging tube axes (parallel to black arrows). (A) Cathedral Peak granodiorite. (B) Half Dome (HD) granodiorite; 15 cm ruler against vertical surface for scale. Subhorizontal surfaces at top of photo and below ruler. (C) HD granodiorite; 15 cm ruler against vertical surface for scale. Subhorizontal surface immediately below ruler with closed schlieren layers. (D) Hornblende phenocrysts in subhorizontal migrating tube in HD granodiorite. A few hornblendes are aligned parallel to schlieren layers, but many define an overprinting fabric or at high angles, as predicted by mineral tumbling experiments (Ildefonse et al., 1997); 15 cm ruler for scale. Note vertical mineral lineation defined by euhedral hornblendes in B and C and that these same hornblendes are more random or aligned parallel to schlieren layers in the subhorizontal surfaces in B–D. Also note that more leucocratic layers often are identical to and/or continuous with host granodiorites.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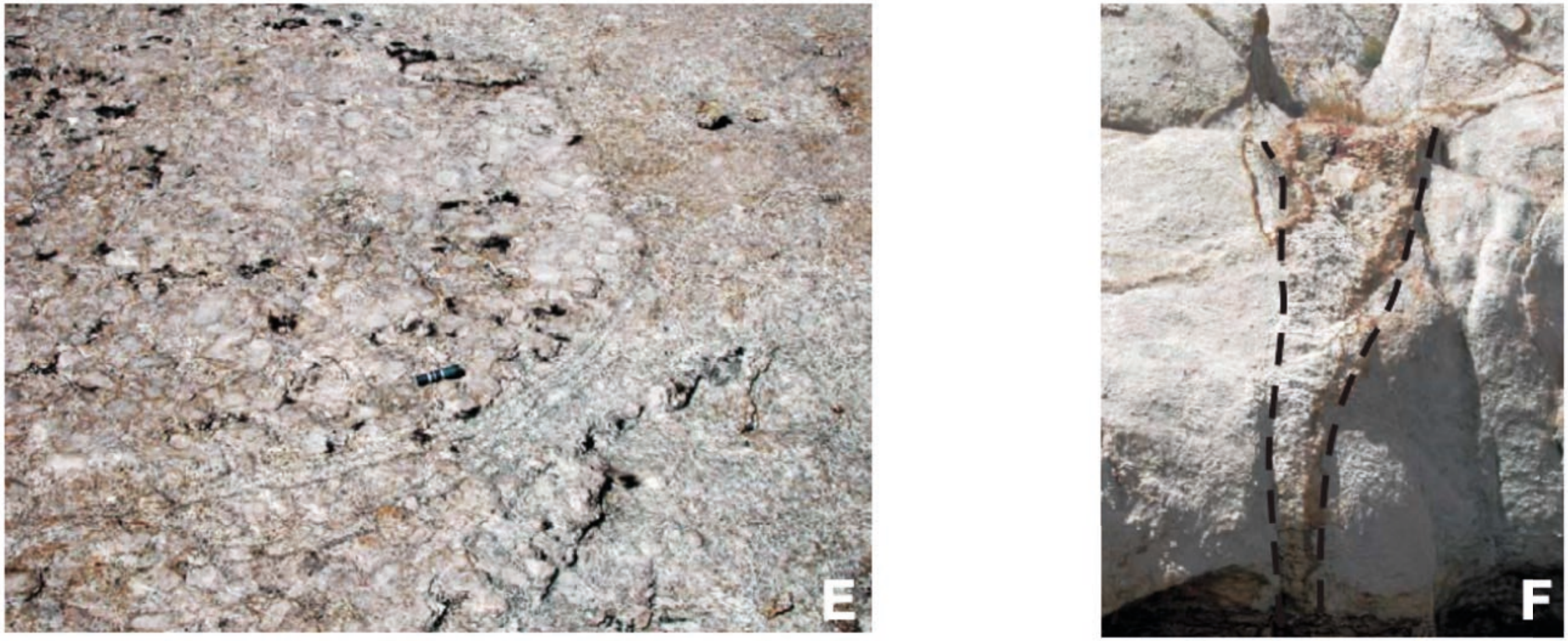

Figure 7. Photos of pipes. (A) Vertical surface through granodiorite pipes in quartz diorite sheets in Kuna Crest unit; 15 cm ruler for scale. (B) Subhorizontal surface through the pipes in A; 15 cm ruler for scale. Note that all pipes are roughly subvertical even in cases where the mafic layering is also steeply dipping (in contrast to Wiebe and Collins, 1998). (C) Horizontal surface through a number of small leucocratic granite pipes in Johnson granite porphyry; 6.5 cm lip balm for scale. (D) Vertical surface through cylindrical pipe K-feldspar megacryst–rich pipes (typically consisting of 60%–80% megacrysts by volume); 25 cm hammer for scale. A minor amount of biotite accumulation occurs along the pipe walls. (E) Closeup of one margin of a K-feldspar megacryst–rich pipes (typically consisting of 60%–80% megacrysts by volume) in the Cathedral Peak granodiorite. Thin schlieren along margin; 6.5 cm lip balm for scale. (F) Vertical surface through funnel-shaped pipe. Top of pipe is ~1 m across.

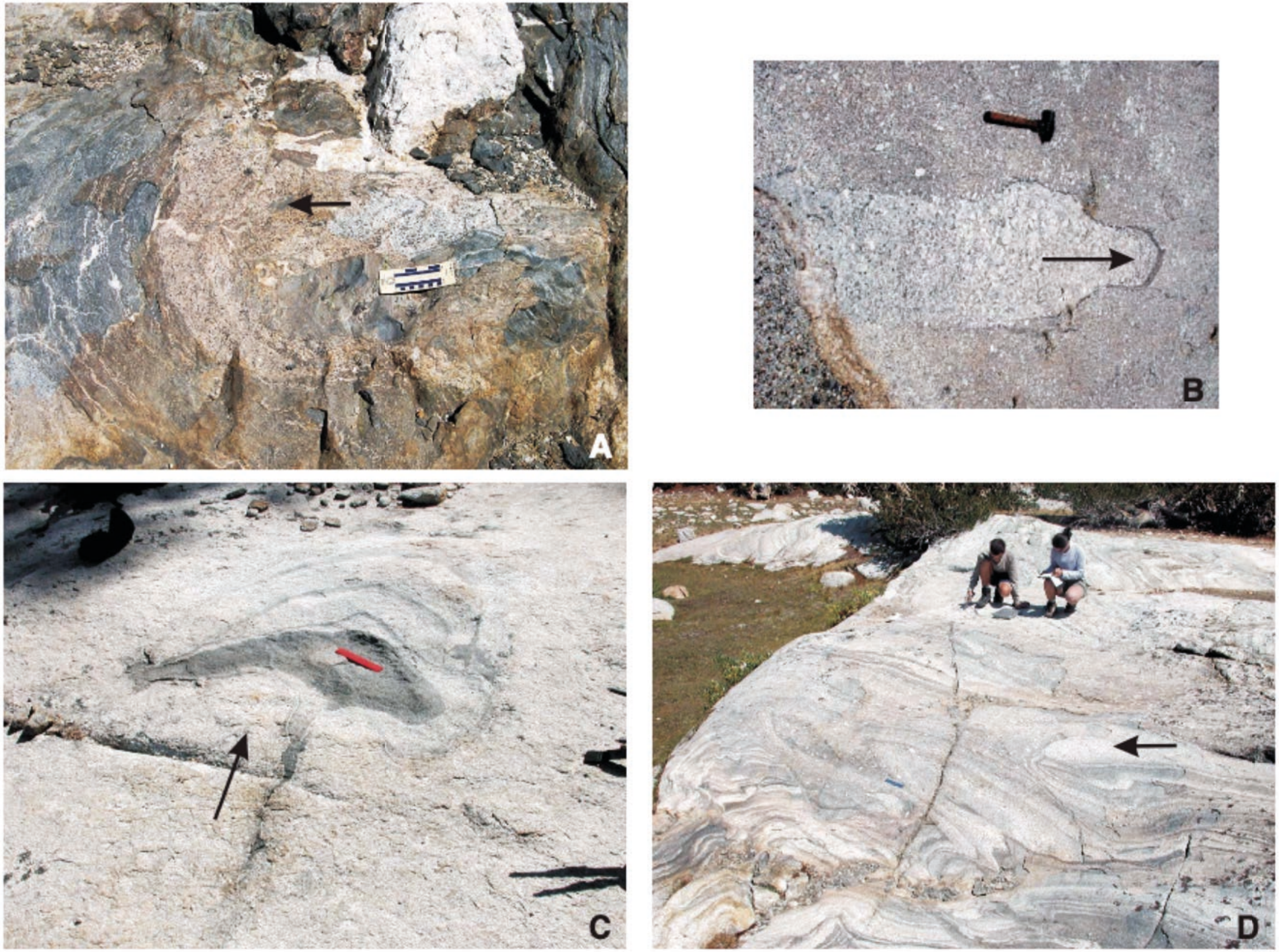

Figure 11. Photos of local diapirs with arrows showing inferred movement direction. (A) Mushroom-shaped diapir of Kuna Crest unit granodiorite in Sawmill Canyon pushing metavolcanic host rocks laterally away from the eastern margin of the Tuolumne batholith; 10 cm ruler for scale. (B) K-feldspar megacryst–rich diapir in Cathedral Peak granodiorite unit. Note accumulation of mafic minerals (mainly biotite and accessories) at the top of diapir; 25 cm hammer for scale. (C) Laterally moving diapir of quartz diorite in transitional phase of the Half Dome (HD) granodiorite; 15 cm ruler for scale. (D) Obliquely moving diapir of K-feldspar megacryst–bearing HD granodiorite, Sawmill Canyon area, moving into and deflecting schlieren layers in magmatic troughs.

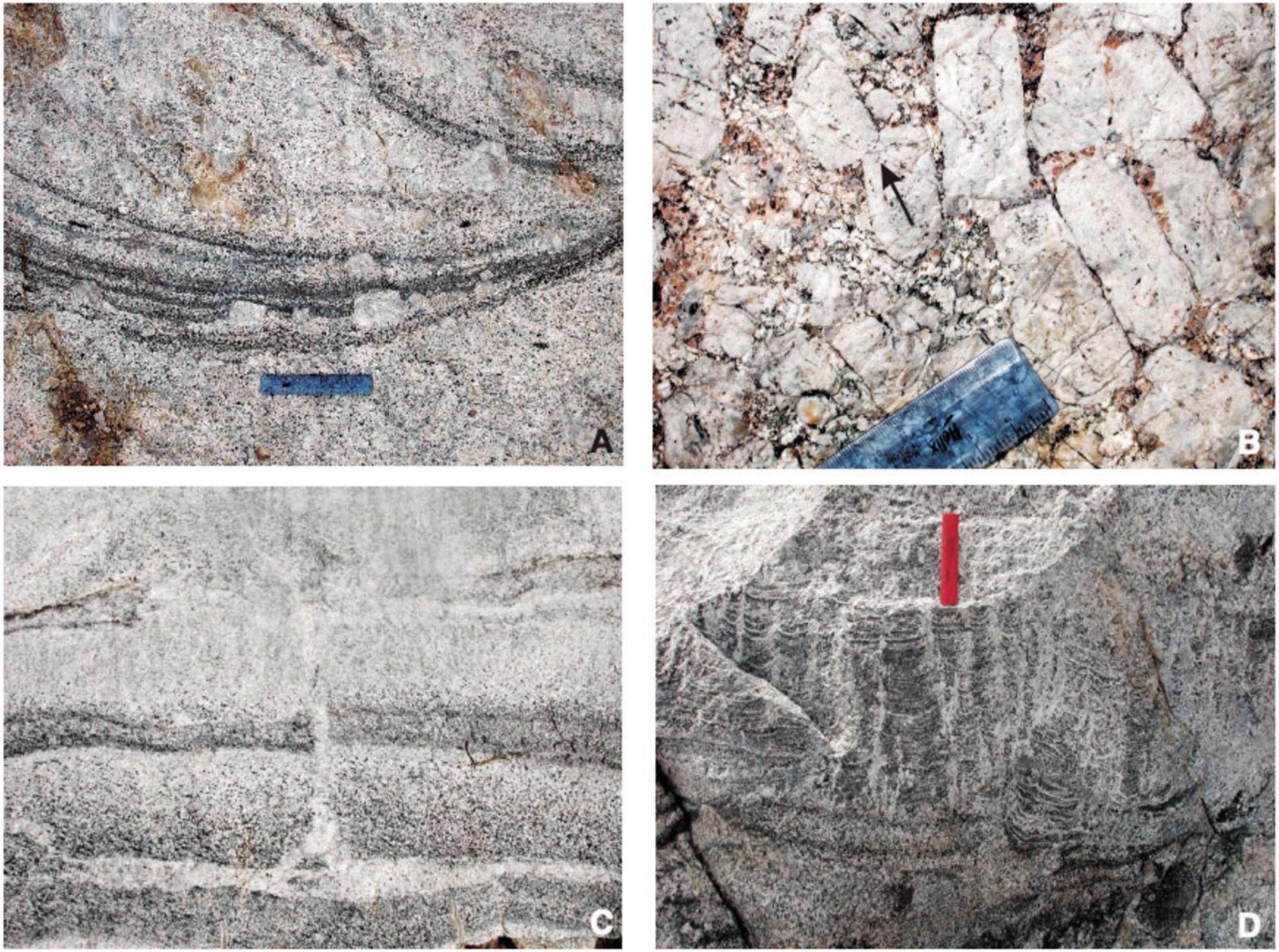

Figure 16. Photos of evidence of compaction during filter pressing associated with structures discussed in this paper. (A) Schlieren indented by K-feldspar megacrysts in trough in Cathedral Peak granodiorite (CP); 15 cm ruler for scale. (B) Closely packed and sometimes touching K-feldspar megacrysts in pipe in CP. Note that the touching megacrysts sometimes indent and truncate zoning in others (e.g., in front of black arrow), indicating compaction and likely contact melting (e.g., Park and Means, 1996; Paterson et al., 2005). End of 15 cm ruler for scale. (C) Layered mafic and felsic schlieren with vein of felsic material draining from a felsic layer through the overlying layers. Width of bottom of photo is ~0.5 m. (D) Dish and pillar–like structures (see text) formed as felsic melts rose through thin mafic layers, during which the rise of melts bent the mafic layers into small dish-shaped segments; 15 cm ruler for scale.