Supplementary Material for:

Wakabayashi, J., 2021, Subduction and exhumation slip accommodation at depths of 10-80 km inferred from field geology of exhumed rocks: Evidence for temporal-spatial localization of slip, in Wakabayashi, J., and Dilek, Y., eds., Plate Tectonics, Ophiolites, and Societal Significance of Geology: A Celebration of the Career of Eldridge Moores: Geological Society of America Special Paper 552, https://doi.org/10.1130/2021.2552(12).

Figures 7, 8, 10, 11, 12, 13

Figure 7. Sunol Regional Wilderness of the northwestern Diablo Range is shown. Blueschist facies imbricate sheets have high clastic and siliciclastic and serpentinite mélange proportions. Updated from Wakabayashi (2017a).

Figure 8. Reconnaissance map shows the Laguna Mountain Area, southern Diablo Range. Lawsonite-albite facies imbricate sheets have abundant detrital serpentinite and mixing between siliciclastic and detrital serpentinite. Contacts in parts of this map have been revised from those of Dibblee and Minch (2007) using aerial and ground imagery.

Figure 10. Some details in these photos are best viewed by zooming in on the electronic version. (A, B) Field photos from Marin Headlands (Fig. 3), (C) Point Richmond (location on Fig. 3), (D) Laguna Mountain (Fig. 8), and (E–G) Mt. Diablo (Fig. 5) show imbricate structures as well as (A, E, and F) the interlayering of mélange horizons within clastics. In parts C and D, all dashed lines are faults because they truncate the sandstone/shale bedding; without this bedding these faults would be difficult to identify. In the other frames, some of the lithologic contacts are likely faults because they invert parts of ocean floor stratigraphy (basalt over chert or clastics or chert over clastics), whereas some are depositional. Photos A, B, and E–G show imbrication of basalt-chert-clastic ocean plate stratigraphy at different scales. Block-in-matrix structures developing from progressive deformation (tectonic mélange) are apparent in the upper parts of B (little deformed basalt in sheared basalt matrix), C and D (sandstone blocks in shale matrix), and G (upper part: mostly chert and/or basalt in shale matrix). In F, a thin (≤0.5 m) layer of pebbly mudstone within bedded sandstone and shale of E includes a 0.5 m block of garnetite/garnet amphibolite that is much higher in metamorphic grade than the lawsonite-albite pebbly mudstone, sandstone, chert, and basalt. Also visible in E and F are conjugate normal faults, which are best seen in the basalt horizon and its borders. Part H shows an extensive outcrop of undeformed lawsonite-albite facies pillow basalt on Mt. Diablo. Continuous exposures in this view are >40 m high and representative of this area (Wakabayashi, 2021). Part I shows a garnet amphibolite block-in-mélange ("high-grade block") from Ring Mountain, Tiburon Peninsula (Fig. 3), with actinolite-chlorite-phengite (metaultramafic) schist selvages. These internal metaultramafic selvages are common in high-grade blocks (see also photo of larger block in Fig. 12B and photos in Wakabayashi (2019). A and B are revised and adapted from Wakabayashi (2017a). E–G are adapted from Wakabayashi (2021). Photo C was taken by Chelsea Hutchens.

Figure 11. Some details in these photos are best viewed by zooming in on the electronic version. (A–G) Photos from northern Shell Beach, Sonoma County Coast (Fig. 6), show evidence for sedimentary origin of siliciclastic matrix mélanges as part of the clastic component of OPS (with bedded sandstone and mudstone), show the larger-scale structure (A and D), and illustrate the scale independence of block-matrix relationships from cobble size to blocks of tens of meters. The rocks here are prehnite-pumpellyite facies except for some of the blocks that are higher grade. (A) Basalt blocks are shown within interbedded conglomerate (siliciclastic matrix) and sandstone. Bedding is represented by resistant ribs in the wave cut platform; these define folds and possible fault cutoffs. (B) Undeformed to little-deformed pebbly mudstone matrix is shown in contact with a 20+ m basalt block (shown in part A) associated with a block

reentrant (left), but this matrix is deformed elsewhere. (C) A fold in sandstone and conglomerate is shown and the impact of deformation that has overprinted the conglomerate, locally forming block-in-matrix relationships (tectonic mélange). (D) Exposures are shown that may include an ocean plate stratigraphy-repeating fault (fault zone marked with dashed red lines in lower left). The fault zone appears to have also generated block-in-matrix relationships. An overturned fold repeats a horizon that ranges from mudstone with sandstone interbeds to siliciclastic matrix. Sandstone beds in mudstone have been boudinaged to form tectonic block-in-matrix texture (which is best seen directly right of the folded sandstone). (E) The interfingering/gradational sedimentary contacts between pebbly mudstone, mud-matrix conglomerate, and sand-matrix conglomerate (locally clast-supported) are shown. A significant deformational overprint is visible in parts of the foreground exposures, especially front center-right, but undeformed domains present in both mud- and sand-matrix rocks preserve sedimentary textures. These outcrops are located a few meters north of figure 16D of Wakabayashi (2015a). (F) Close up of coarse-grained blueschist "blocks" in part E shows them to be one block that has been deformed and pulled apart. Most of the host rock is sand-matrix or clast-supported conglomerate with limited zones (dark gray) of mud matrix conglomerate (G) Cliff base exposures ~250 m south of those of part E show strongly deformed siliciclastic mudstone (dark gray) with mafic-ultramafic-rich layers (greenish to dark olive-green). The deformation has obscured or obliterated the sedimentary textures in parts of this outcrop, but sedimentary textures are easily seen in much of it, with common occurrence of rounded cobbles. In the more deformed zones, the origin of clasts/blocks as sedimentary versus tectonic-generated becomes less clear. (H) From blueschist facies rocks of the North Fork Pacheco Creek NW of Pacheco Pass (Fig. 3), a thin (10–15 m thick) horizon of mud-matrix mélange is shown within otherwise bedded siliciclastic rocks. Some domains within the mud-matrix horizon are weakly deformed and show the original sedimentary relationship between clasts and matrix, whereas other domains are more severely deformed and obscure the sedimentary clast-matrix relationship. The horizon grades upward from mud matrix sedimentary breccia/conglomerate to sand matrix conglomerate and bedded sandstone/mudstone. Imbricate and anastomosing faults of the sort seen in the bedded clastic rocks of Figures 10B and 10C are visible in the upper part of the photo. Similar to Figures 10B and 10C, the faulting and deformation locally results in the generation of tectonic blocks. One sandstone block has a deformed "tail" (labeled), and it is not clear whether this block was generated by tectonism or whether it was a sedimentary block that has been deformed.

Figure 12. Some details in these photos are best viewed by zooming in on the electronic version. Photos show a 60 m garnet-diopside-amphibolite block in prehnite-pumpellyite facies siliciclastic matrix mélange, northern Shell Beach (Fig. 6), which illustrates (A, B) the scaling up of sedimentary clast-matrix relationships and (C, D) sedimentary clast/block-matrix textural details. Part C also shows a selvage of clastic serpentinite that includes siliciclastic detritus (photomicrographs in Figs. 13A and 13B) and a small block of jd-lws–bearing metasandstone (Figs. 13E–13F). Matrix photomicrographs are shown in Figures 13C and 13D. (B) Adapted from Wakabayashi (2019). (D) Shows a view, similar to that of figure 20D of Wakabayashi (2015a), but more zoomed out and taken at a later date, when much of the slope wash that covered most of the matrix in the 2015 photo had been removed by heavy rainfall. Note that part of the view in part C has been partially obscured by subsequent rockfall of amphibolite boulders.

Figure 13. Some details in these photos are best viewed by zooming in on the electronic version. PPL denotes plane polarized and XPL denotes cross polarized light. (A–H) Photomicrographs show the garnet-amphibolite block of Figure 12 as well as clasts and matrix around it (sample locations in Figs. 12A and 12C). These photographs illustrate the sedimentary relationships in the matrix at sand scale and the wide range of metamorphic grade of clasts and blocks in the prehnite-pumpellyite facies matrix as well as sedimentary mixing of detrital ultramafic/metaultramafic and siliciclastic material. (A, B) Some quartz (qtz)-rich clasts and hornblende (hb) clasts are included in otherwise detrital serpentinite that shows deformation, especially of some serpentinite (antigorite schist) clasts that are strained, and some recrystallized tails are shown in some domains, but there are many unstrained original detrital grain

boundaries, particularly those at high angles to the locally developed foliation, as well as nearly all of the grain boundaries in the labeled, lightly deformed domain, some of which show pressure solution geometry. Many undeformed grain boundaries abruptly truncate internal clast fabric. (C, D) Siliciclastic matrix shows little deformation and includes at least one blueschist clast and tremolite schist (metaultramafic clast). (E, F) These are from a blueschist facies sandstone block (ab—albite, jd—jadeite, lws—lawsonite), which is very similar to coherent Franciscan rocks found in the eastern part of the northern Coast Ranges as well as the Diablo Range. (G, H) The large garnet-amphibolite block is shown (am—amphibole, cpx—clinopyroxene, grt—garnet). (I–N) Features of the thin, pebbly mudstone horizon and included garnetite/garnet-blueschist/amphibolite block of Figure 10F from Mt. Diablo are shown. (I) A scan of a thin section of the garnetite, illustrating its unusual sandstone-like texture, is shown. The dark areas are amphibole rich (primarily glaucophane). (J) Scan of a thin section of a 20-mm-size clast of garnetite/garnet-blueschist in pebbly mudstone matrix (dark), which is preserved in the sample along the upper (in the photo) margins of the sample. (K) Part of the garnetite thin section is shown; most of this view is garnets of varying sizes. (L) The 20 mm garnetite clast. (M, N) Views of the pebbly mudstone. Relatively scarce fine lawsonite is the only high P metamorphic neoblastic mineral present. Whereas a metamorphic foliation and associated deformation are well developed, the sedimentary clastic texture is still preserved in the less-deformed microlithons. (O–Q) Mixed serpentinite-siliciclastic matrix from the Laguna Mountain summit area (Fig. 8). (O) The polished side of the thin section billet shows the strong deformational overprint on the sedimentary clastic texture. A lightly deformed domain with undeformed rounded clast is shown. (P) Siltstone (slt) and shale (sh) clasts are common. Most of the remaining clasts are antigorite schist or chlorite schist clasts with some mafic/ultramafic mineral grains (such as the labeled cpx grain). The siltstone and shale clasts probably include significant component as seen by the fibrous/platy antigorite or chlorite that makes up much of the material with blue-gray birefringence in part Q. Fine detrital quartz and feldspar are present, distinguished from the chlorite or antigorite by fairly even extinction, and contrasted with the wavy extinction of the latter. Arrows show examples of what appear to be relatively undeformed primary detrital grain boundaries that are oriented at high angles to the foliation and with a geometry that reflects pressure solution. Although such grain boundaries are locally preserved, most of the grains and their boundaries show significant deformation. (R–T) Different textures in eclogite assemblages preserved in high-grade blocks. (R) From a block from Ring Mountain showing a lack of preferred orientation of omphacite (omp) and epidote (ep). In contrast, S, from a different block at Ring Mountain (Fig. 3), and T, from Mt. Diablo (Fig. 5), show strong linear and planar preferred orientation of (L-S tectonite) omphacite ± epidote ± phengite (phen).