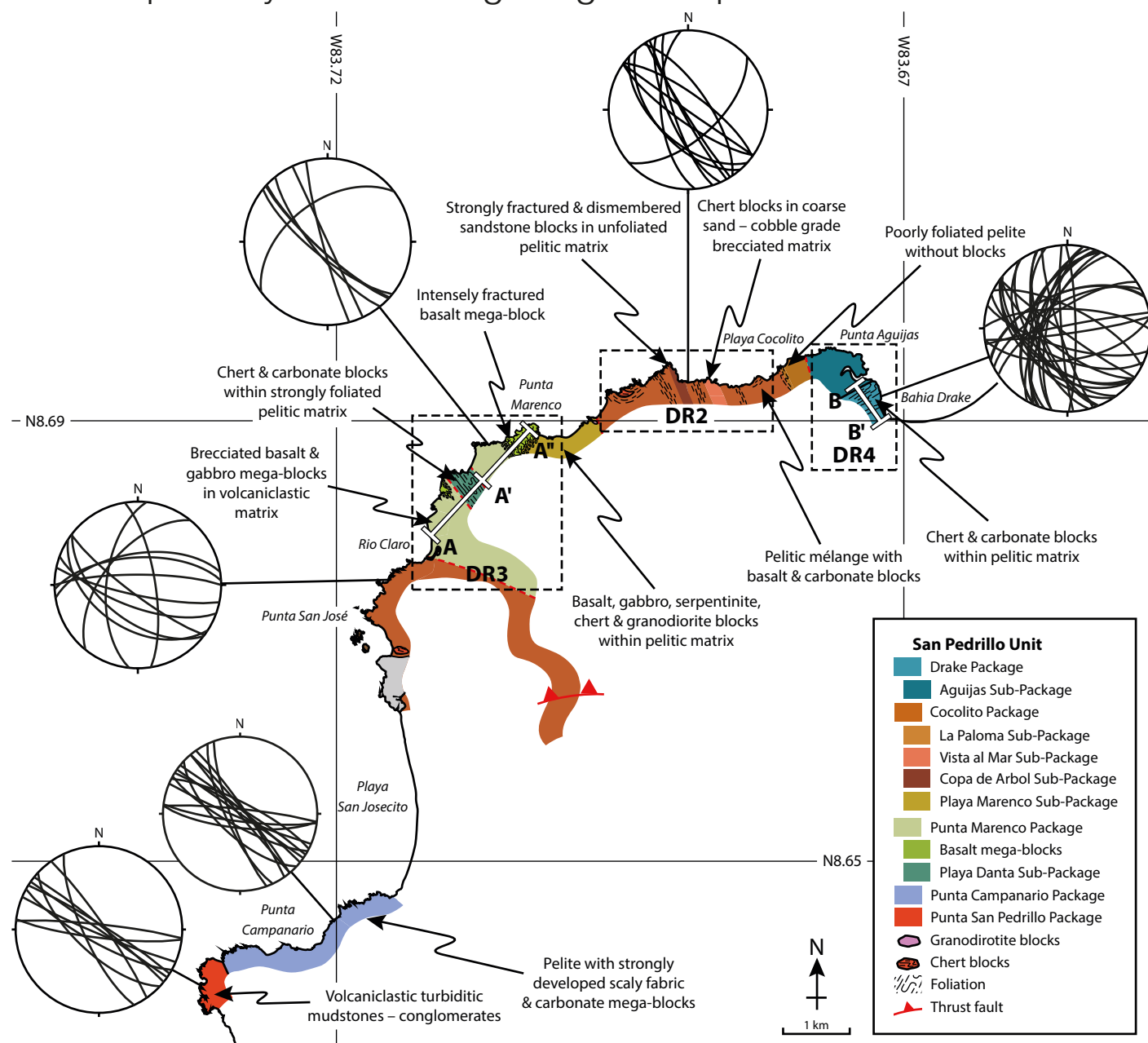


# Data Repository 1: Detailed geological map of the San Pedrillo Unit



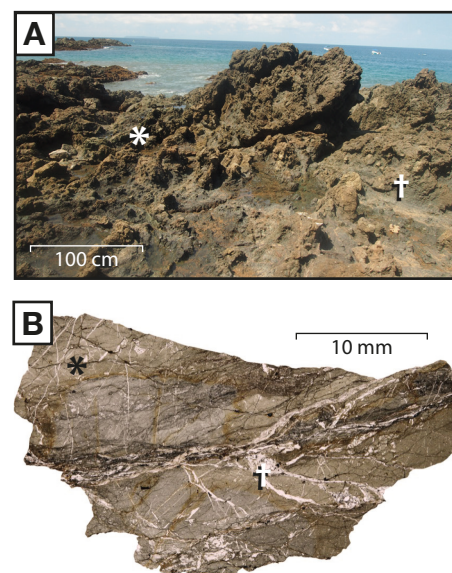
**Geological map of the San Pedrillo Unit of the Osa mélangé from Bahia Drake to Punta San Pedrillo showing lithological and structural variation. Inset stereoplots show dominant foliation in each area.**

## Data Repository 2: Cocolito Package

The Cocolito package consists of low – moderate aspect ratio blocks of mudstone, sandstone, chert, carbonate, and basalt within a predominantly pelitic matrix (A). This matrix lacks a consistent foliation but possesses a strongly developed scaly fabric (B) with pervasive anastomosing slip surfaces and localised shear bands (B†). Some blocks are brecciated with injections of matrix into fractures leading to progressive dismemberment towards the block margins. The La Paloma sub-package is a ~400 m thick pelite unit containing no blocks. The Vista al Mar sub-package has a coarse sand – cobble grade matrix consisting

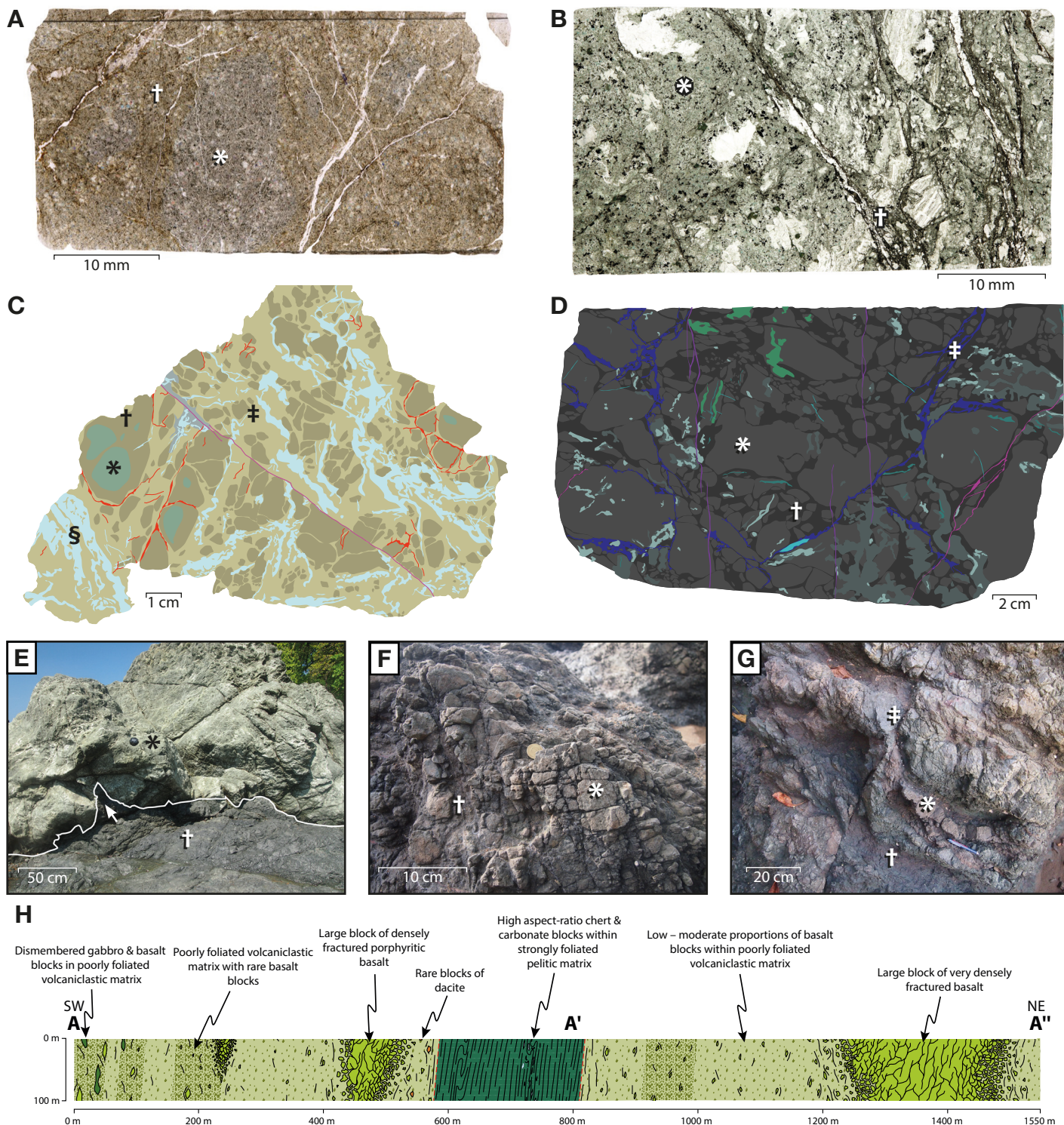
of red and teal chert with rare blocks of high aspect-ratio chert that display no preferred orientation. The Copa de Arbol sub-package features mudstone and sandstone blocks that are pervasively brecciated, and the Playa Marengo sub-package contains 10s of cm – 10s of m-scale blocks of basalt, gabbro, serpentinite and granodiorite.

**A: Typical outcrop appearance of Cocolito package showing varied blocks (\*) in unfoliated matrix (†) (N 8° 41' 39.5", W 83° 41' 31.2"). B: Pelitic matrix with scaly fabric (\*) and localised shear bands (†) with veining concentrated along shear bands.**



# Data Repository 3: Punta Marengo Package

The Punta Marengo package consists of 100 m-scale mega-blocks of basalt within a volcanoclastic matrix. cm – 10s of m scale blocks of basalt, gabbros, chert and rare dacite are also present. Block aspect ratios are low – moderate and display no preferred orientation. Basalt mega-blocks are strongly brecciated with injections of matrix into the fractures leading to progressive dismemberment towards the block margins. This brecciation, combined with pervasive alteration of the basalt by through-going fluids, has lead to the development a block-in-matrix texture within the basalt mega-blocks (A, C & F) Within this unit is the Playa Danta sub-package, a ~400 m-thick unit of dismembered chert and pelite displaying a strong foliation defined by block alignment.

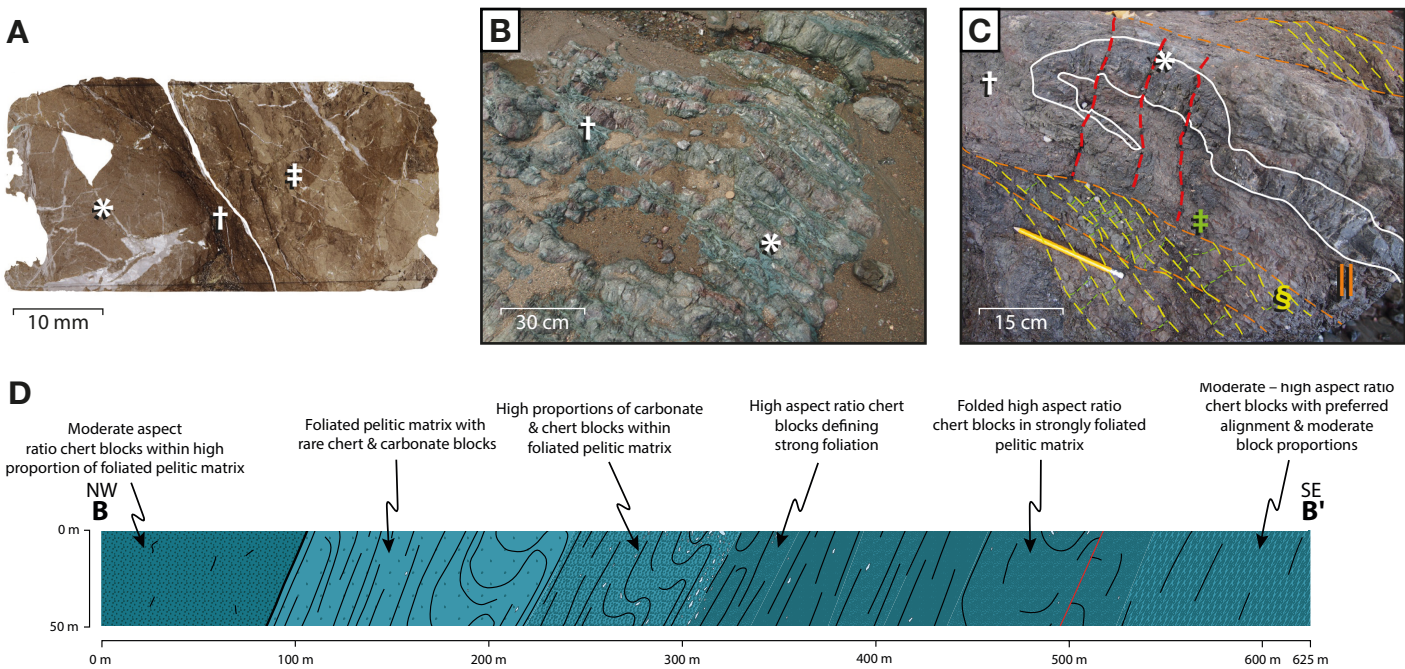


**A:** Photomicrograph of altered basalt block showing “fresh” cores (\*) containing unaltered feldspars and altered matrix (†) predominantly composed of clays. **B:** Photomicrograph of deformed volcanoclastic matrix showing phacoids (\*) and localised shear zones (†). **C:** Illustrated interpretation of cut surface of altered basalt blocks showing “fresh” cores (\*), partially altered core rims (†) and sheared matrix (‡) cut by folded calcite veins (S). **D:** Illustrated interpretation of cut surface of volcanoclastic matrix showing brecciated phacoids (\*) in sheared matrix (†) with dark gouge-filled fractures (‡). **E:** Gabbro mega-block (\*) in volcanoclastic matrix (†) with matrix injections into fractures (arrow) (N 8° 40' 50.5", W 83° 42' 43"). **F:** Brecciated basalt mega-block displaying brick-like geometric regularity (\*) with “matrix” of comminuted basalt fracture fill (†) (N 8° 41' 22.7", W 83° 42' 13.3"). **G:** Dismembered chert & pelite with aligned high aspect ratio blocks (\*) in pelitic matrix (†) cut by minor fault (‡) (N 8° 41' 30.8", W 83° 40' 18.0"). **H:** Cross-section from A to A'' in DR1 (A and A' in this figure corresponds to B and B' in Fig. 2).



# Data Repository 4: Drake Package

The Drake package consists of strongly dismembered interbedded chert and pelite with minor blocks of carbonate and a strong foliation defined by block alignment. Chert blocks are typically cm – m-scale with moderate to ultra-high aspect ratios and occasional isoclinal folding. Carbonate blocks are m – 10s of m-scale lenticular blocks displaying pinch and swell structures. The Punta Aguijas sub-package to the north of Bahia Drake contains higher proportions of chert and lacks foliation.



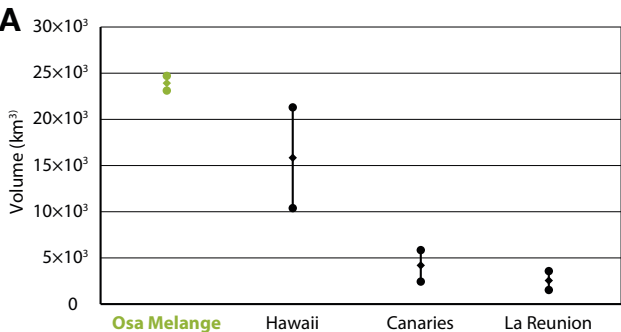
**A:** Photomicrograph showing fractured and veined pelite block (\*) within sheared pelitic matrix displaying scaly fabric (†). Partially brecciated pelitic block (‡) also present. **B:** Aligned red chert blocks (\*) within matrix of green pelite (†) (N 8° 41' 35.1", W 83° 40' 18.5"). **C:** Isoclinally folded chert block (\*) within pelitic matrix (†) showing D<sub>1</sub> extensional fractures (‡, green), D<sub>2</sub> S surfaces (§, yellow) and D<sub>2</sub> C surfaces (||, orange) (N 8° 41' 26.6", W 83° 40' 17.4"). **D:** Cross-section from B to B' in DR1.

# Data Repository 5: Comparative Scale of the Osa Mélange and seamount moats/debris aprons

The cross-sectional area of Osa mélange is derived by subtracting the estimated area of frontal prism from the estimated area of forearc wedge up to the landwards extent of the Osa mélange (45 km); at this point, the thickness is estimated to be 10 km. The frontal prism extends from the trench to the seaward limit of the Osa mélange (10 – 15 km) and the thickness at this point is calculated to be 2.2 – 3.3 km. This yields an Osa mélange cross-sectional area estimate of 200 – 214 km<sup>2</sup>. The volume of the Osa mélange is estimated as the product of its cross-sectional area and its trench-parallel length (115 km), yielding an Osa mélange volume estimate of 23.0 – 24.6 × 10<sup>3</sup> km<sup>3</sup>.

The cross-sectional area of the Hawaiian, Canary Islands and La Reunion moat/debris apron deposits was calculated following the method described in ten Brink & Watts (1985), where the geometry of these basins is considered as a wedge and the thickness is calculated from the difference between the two-way-travel-time to the top of the sedimentary package and the basement and the p-wave velocity is considered to be 3.5 km/s.

Fig. A shows the estimated volumes of the Hawaiian, Canary Islands and La Reunion moat/debris apron deposits over an arbitrary length of 100 km in comparison to the volume of the Osa mélange. This shows that the volume of the Osa mélange is comparable (within 2 orders of magnitude) with the volume of modern moat/debris apron deposits.



	Hawaii	Canary Islands	La Reunion
Width (lower estimate)	70	100	50
Width (upper estimate)	140	250	130
Maximum thickness	3	0.5	0.5
Area (lower estimate)	105	23	13
Area (upper estimate)	210	57	34

**A:** Graph showing the estimated volume of the Osa mélange and Hawaiian, Canary Islands and La Reunion moats, calculated as described in DR 5. Volumes for the Hawaiian, Canary Islands and La Reunion moats are calculated by multiplying the cross-sectional areas (B) by an arbitrary length of 100 km. **B:** Table showing values of width and thickness used to calculate estimated cross-sectional areas of Hawaiian, Canary Islands and La Reunion moats/debris aprons.