

Supporting Information

Unraveling the Effect of Convergence Obliquity on Overriding-Plate Deformation and Strain Partitioning in Subduction Zones

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S1) Correlation between O_{v_d} , $\bar{O}_{v_d}$ and other subduction parameters

We analyze the correlation between the deformation obliquity O_{v_d} and other subduction parameters, including the convergence velocity, the absolute velocity of both the overriding and subducting plates, and the slab dip. The absolute velocities are described in four absolute reference frames (Cerpa et al., 2022) : MORVEL56-NNR model (Argus et al., 2011), the spreading-alignment model (Becker et al., 2015), the T25m model (Wang et al., 2018), and the GMHRF-1Ma model (Dobrovine et al., 2012). For all transects with defined v_d , we find that O_{v_d} shows a relatively good correlation with O_{v_c} and α_s and α_d ($r \approx 0.20$), and best correlates with the upper-plate absolute velocities (Figure S1).

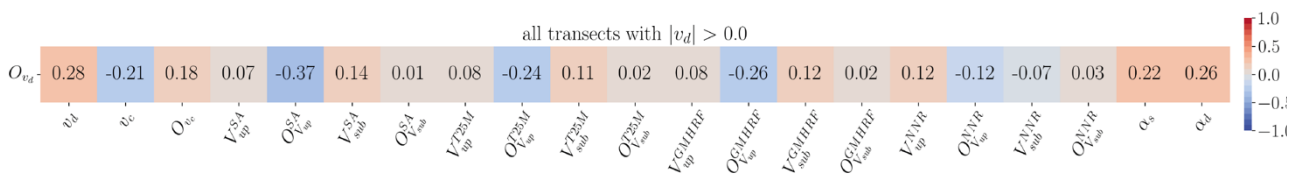


Figure S1: Heatmaps of bivariate Pearson correlation coefficients between O_{v_d} and other kinematic variables related to both relative (v_x) and absolute velocities (V_x^y), as well as with shallow (α_s) and deep (α_d) slab dip (see main text for definitions), for all transects with $|v_d| > 0$ (213 transects). The superscripts for absolute velocities are those described in Cerpa et al., (2022) and as follows: SA=Spreading-alignment model of Becker et al., (2015), T25M=model of Wang et al., (2018), GMHRF=GMHRG-1Ma of Dobrovine et al., (2012), NNR=MORVEL56-NNR model of Argus et al., (2011).

Considering the directed deformation obliquity $\bar{O}_{v_d}$ for all transects with a defined v_d , a similar bivariate correlation analysis shows that it best correlates with the directed convergence obliquity $\bar{O}_{v_c}$ ($r \approx 0.40$, Figure S2). The correlation is higher ($r \approx 0.80$) when considering only the transects that exhibit the same sign of $\bar{O}_{v_d}$ and $\bar{O}_{v_c}$, that are the transects where the deformation is more likely to be driven by convergence and plate-plate mechanical interaction at the plate interface.

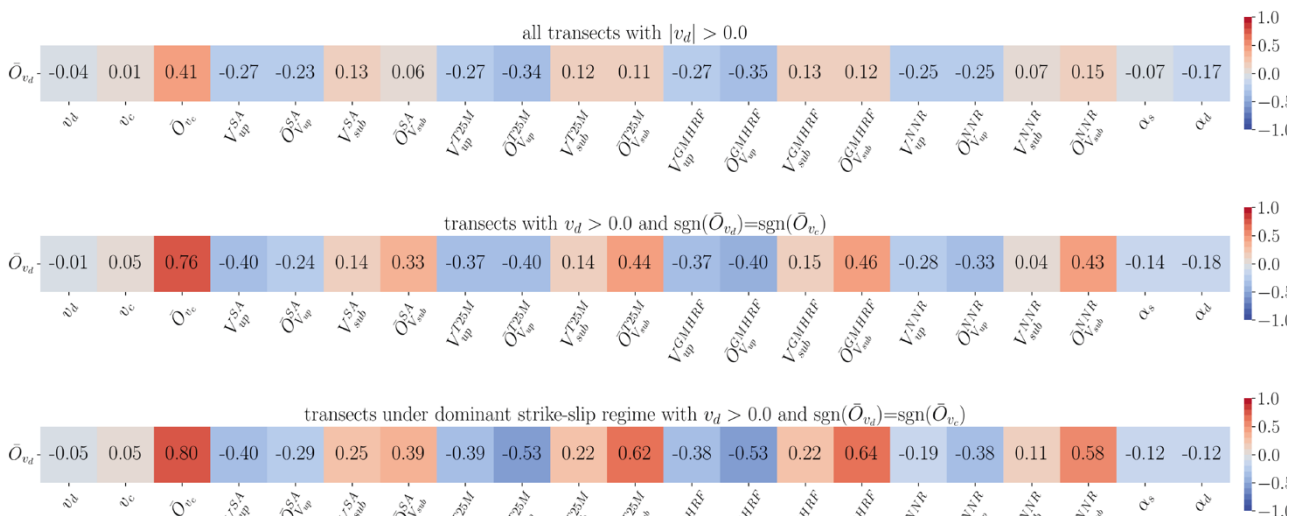


Figure S2 : Heatmaps of bivariate Pearson correlation coefficients between $\bar{O}_{v_d}$ and other kinematic variables, including signed obliquities, as well as with shallow (α_s) and deep (α_d) slab dip (see main text for definitions). Other legend details are as in Figure S1.

S2) Seeking for common characteristics of transects under strike-slip regime

To investigate potential controls on efficient strain partitioning (i.e., low O_{vc} and high p_t), we analyzed several geodynamic characteristics of our transects under a dominant strike-slip regime (Figure 10, Main Text). Specifically, we categorized the transects based on the presence of the following features:

- A topographic anomaly entering the trench (at the transect of nearby)
- A density anomaly at the trench (at the transect of nearby)
- A localized deformation structure in the overriding plate
- A localized deformation structure within the volcanic arc

Table S1 summarizes these observations, including the names of bathymetric features at the trench and the tectonic structures associated with strain partitioning.

We then evaluate the relationship between O_{vc} and p_t for transects exhibiting each of these characteristics (Figure S3). Individually, none of the four features appear to explain efficient partitioning, as they do not isolate transects with relatively low O_{vc} and high p_t . In contrast, the transects that combine both density anomaly at the trench and a localizing deformation structure within the volcanic arc tend to exhibit an efficient strain partitioning, as shown in the main text Figure 10.

Additionally, to test a previous suggestion by Jarrard (1986) regarding the role of crustal type in the overriding plate and the degree of strain partitioning, we compile information on the crustal type of the arc and back-arc regions.

Overall, we found no apparent correlation between the overriding-plate crust type and lateral partitioning (Figure S4), as discussed in section IV.2.4. Furthermore, we found no evidence that this parameter favors an efficient strain partitioning (i.e., relatively high p_t at relatively low O_{vc}).

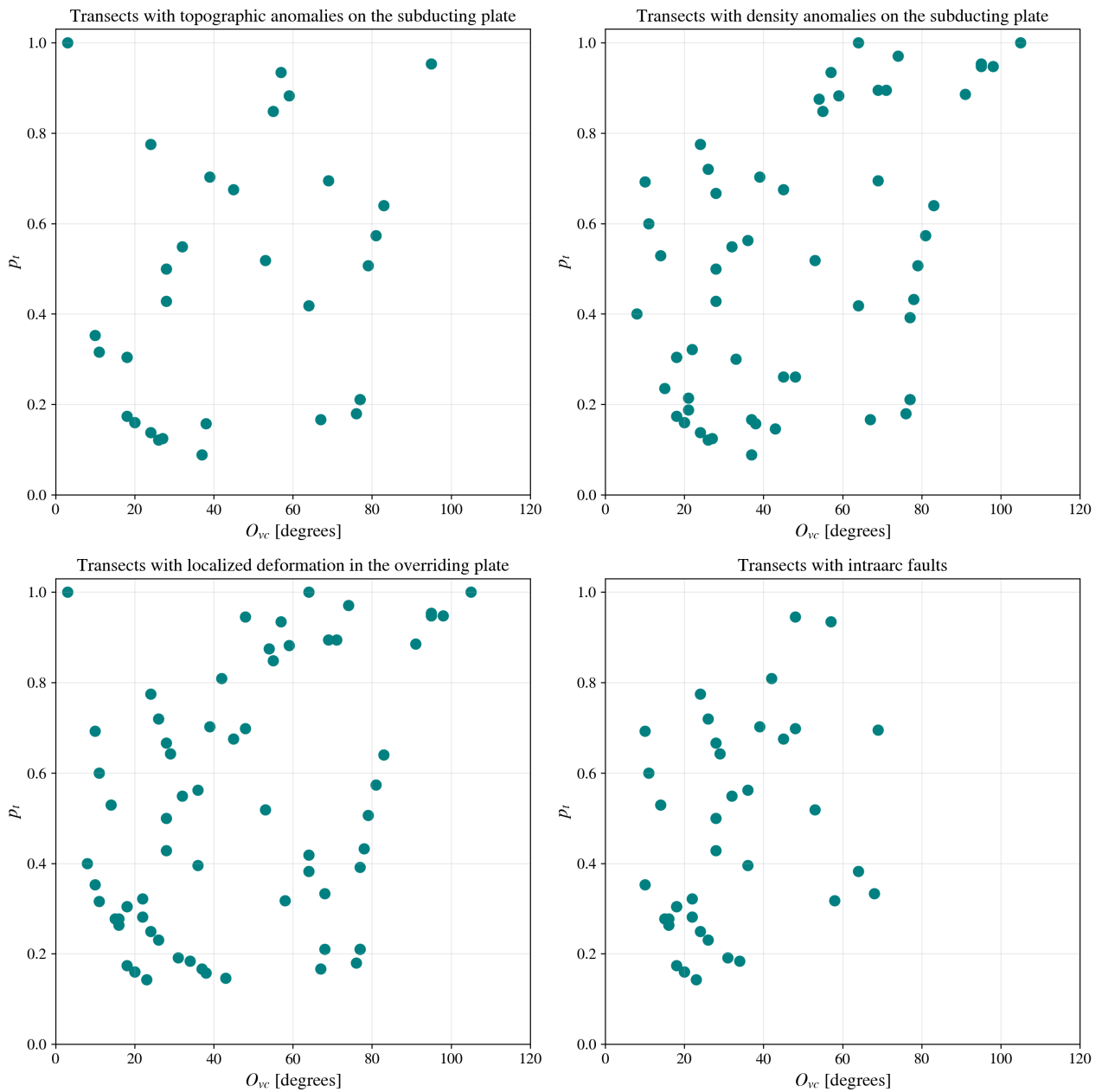


Figure S3 : Lateral partition coefficient p_t with convergence obliquity O_{vc} for several subsets (subpanel titles) of the transects under a dominant strike-slip strain class and with $p_t \leq 1$ (those shown in Figure 10 of the main text).

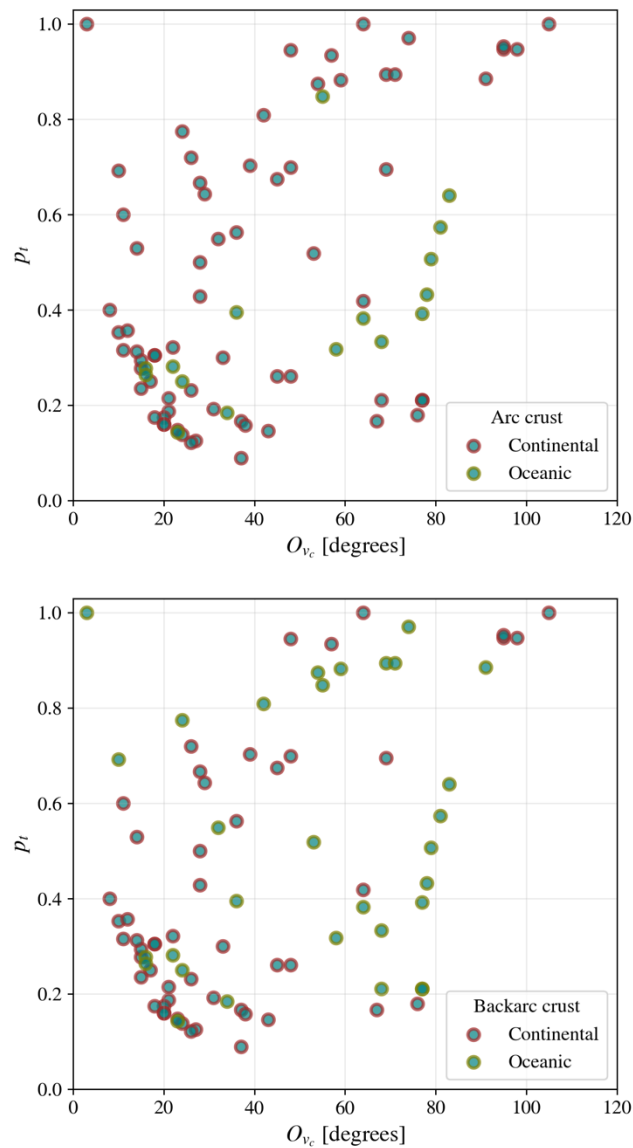


Figure S4 : Lateral partition coefficient p_t with convergence obliquity O_{v_c} colored by the arc (top) and backarc (bottom) crust type for all transects under a dominant strike-slip strain class and with $p_t \leq 1$ (those shown in Figure 10 of the main text).

Table S1 : List of the 86 transects falling under the dominant strike-slip regime and displaying a lateral partition coefficient lower than 1. The table provides the geographic coordinates of the transect, and characteristics of both the subducting and overriding plate which are used to investigate the common features of the transects displaying an efficient partitioning as described in the main text (see section III.3.3 for more details). The features include whether a bathymetric feature enters the subduction trench, the main tectonic features on the overriding plate, and the nature of the crust.

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