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Response: Commentary: Deformation and Fault Propagation at the Lateral Termination of a Subduction Zone: The Alfeo Fault System in the Calabrian Arc, Southern Italy

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A Commentary on

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INTRODUCTION

Argnani (2020) raised concerns about our interpretation of the Alfeo Fault System (AFS) as a lithospheric tear bounding the Calabrian Arc (Maesano et al., 2020). Some of these concerns arise from elements overlooked by Argnani (2020); others are marginally related to our work; none of them implies possible changes in our results in the absence of newer data. We briefly discuss these issues in the following.

PREVIOUS LITERATURE

We confirm to have used an inappropriate citation concerning the assessment of the AFS as a main lithospheric tear; we should have cited Argnani and Bonazzi (2005) instead of Argnani et al. (2012).

Argnani and Bonazzi (2005) concluded that *"the structural features [...] support the occurrence of a lithospheric tear between the ionian oceanic lithosphere and the continental lithosphere of the Hyblean plateau [...]. This lithospheric tear is responsible for the neotectonics of the region, that affects the eastern Sicily slope as far south as Siracusa, with the Malta Escarpment that acted as an inherited weakness zone."* We confirm that our results contradict the above interpretation of the fault mapped by Argnani and Bonazzi (2005), which runs roughly N-S, dips only at c. 30°, and is very shallow with no evidence of deep rooting. The AFS instead is oriented NNW-SSE, very steep, and rooted within the Ionian oceanic crust. North of Siracusa, the AFS and the fault mapped by Argnani and Bonazzi (2005) are very close to each other; as already highlighted by Dellong et al. (2020b), this may explain the disagreement on the two faults. Argnani et al. (2012) adopted the faults proposed by Argnani and Bonazzi (2005), which caused the glitch of our inappropriate citation.

Extrapolating from this inappropriate citation, Argnani (2020) claimed that we intentionally missed a large active extensional basin along the Malta Escarpment north of Siracusa. We firmly rebuke this allegation. Our Figure 8B clearly shows the widespread Plio-Holocene basin to the west of the Calabrian Accretionary Wedge (CAW) front with a thickness greater than the SSTBs. This basin is even much bigger than what Argnani (2020; Figure 1) reported despite the available data to map it (Argnani and Bonazzi, 2005; Figure 3), as it extends from offshore Catania to the south of the Alfeo seamount. We interpreted the growth strata in this basin as resulting from salt tectonics at the CAW toe (our Figure 5A; see also Maesano et al., 2017) and not to the activity of normal faults.

NORTHERN EXTENT OF ALFEO FAULT SYSTEM

The Tindari-Taormina Fault (TTF) was outside the study area of our work, and we have not analyzed any direct data concerning it. We thus mentioned works by others (Introduction) and only noted that the TTF offshore prolongation (southern end) shares the same approximate strike and map position with fault F4 (northern end). We thus marked the TTF and faults F1-F4 with different line styles in Figure 7A. In the 3D diagram (Figure 10), we showed that the TTF (represented by a dashed line) only affects the upper plate in agreement with our previous work on the Calabrian Arc (Maesano et al., 2017).

SHALLOW SYN-TECTONIC BASINS AND AGE ATTRIBUTION

Regarding the genetic relationship between the AFS and the Shallow Syn-Tectonic Basins (SSTBs) development and age, any well-grounded different interpretation is always welcome, but Argnani (2020) neither proposed a different explanation nor provided evidence to challenge our interpretation. We proposed a mechanism entirely based on a data-driven geometric reconstruction that relates shallow brittle features to deep-seated major faults (F1-F4), also supported by analog models (Bonini et al., 2015; Bonini et al., 2016). In the absence of any direct age determination, we assumed that all the AFS segments had a coeval activation below the widespread SSTBs (our Figure 8B). The basins coalescent geometry in the northern part hints at the contemporaneous activity of F2-F4 underneath, whereas the progressively reduced thickness of the elongated basin in the southern part hints at a progressively reduced accommodation space created by F1. Our Figure 9B clearly shows the dragging of unit U1a near the shallow secondary fault that is the early syncline effect, likewise similar features found in all the other profiles. We maintain that the online version of our Figure 5 is of high-enough resolution to support the interpretation of the SSTBs younger age in profile E relative to profile A.

We did not use sediment compaction to discuss the estimates of the AFS activity rates because the absence of calibration data in the area would have led to unreliable results; otherwise, the details of that procedure would have been provided (e.g., Maesano et al., 2013; Maesano et al., 2015; Maesano and D'Ambrogi, 2016). We repeatedly cautioned the readers about the need to consider the inferred throw-rates as minimum estimates.

SUPPOSED UNDER-EXPLORED TECTONIC ISSUES

The supposed differences between our interpretation and the work by Dellong et al. (2018) are specious because the two works, in reality, complement each other. The refraction profiles by Dellong et al. (2018) and Dellong et al. (2020a) have a resolution that captures large-scale features, whereas our data resolution permits focusing on the fault zone complexity. Similarly, we used the data at higher resolution by Gutscher et al. (2016) for aiding the interpretation of the shallower part of the structure. Overall, our interpretation is a novel contribution that complements the interpretations proposed by Gutscher et al. (2016), Gutscher et al. (2017), Dellong et al. (2018), Dellong et al. (2020a) and confirmed by Dellong et al. (2020b).

On a different note, instead, is the occurrence of serpentinite diapirs discussed by Polonia et al. (2017), which were well acknowledged in our work. We reported the diapir positions in Figure 8 to help interpret the sediment thickness variations. However, further analyses about these diapirs were beyond our scope, and the topic remains open for future work.

We remark that there are certainly under-explored aspects in our study like there always are in any study. Our work focused on a few AFS specific aspects, not on making its ultimate review.

NATURAL HAZARD IMPLICATIONS

Finally, Argnani (2020) stated that the AFS "*has little if any capability to generate tsunamis.*" without providing any physical basis for this assessment. Indeed, the decoupling of the deep AFS from the faults bounding the SSTBs can hardly be a reason. If one applies the seismic parameterization of Argnani et al. (2012) to the AFS obtains comparable tsunami amplitudes both in the near- and the far-field of the source (Basili et al., 2020). The topic, however, is marginally related to this discussion because we did not tackle the reconstruction of the January 11, 1693 earthquake and tsunami, which is the subject of a long-lasting debate (Piatanesi and Tinti, 1998; Tinti et al., 2001; Gutscher et al., 2006; Visini et al., 2009; Pirrotta and Barbano, 2020).

FINAL REMARKS

This commentary touched just a few aspects of an offshore fault system, the AFS, that gained attention only in the last decade. The

AFS role as the Calabrian Arc lateral termination has already been preferred among older and recent alternative views (Gutscher et al., 2017). Hopefully, this exchange will stimulate future in-depth studies to shed light on the seismotectonics of this particular corner of the central Mediterranean and further explore the tectonic implications of these recent findings.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.