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Interactive comment on "A first estimation of the contraction related to vertical axis rotation: the case of the Ibero-Armorican Arc formation" *by* Josep Maria Casas et al.

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Dear Massimo, Thank you very much for your comments. Yes, paleomagnetic data have been used as an evidence for the orocline model. However, it should be noted that they are not easy to interpret. Some of the involved rocks in the southern arm of the arc have not provided interpretable results, and in the other hand the results obtained differ in both branches of the arc. As you noted, the aim of our contribution in not discussing this data. We are dealing with geometrical aspects referred to contraction related to the arc formation. However, some points concerning paleomagnetic data can be considered:

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Discussion paper

1) The paleomagnetic results are quite different in the northern branch of the arc, in the core of the arc (Cantabrian zone) and in the southern (western) arm of the arc. In the northern branch, a ca. 25° clockwise rotation is proposed by Pastor-Galán et al. (2015b) to form the arc. In the central area, a post-Variscan folding and pre-orocline formation remagnetization suggests that the arc formation is due to late Kasimovian-Moscovian-Gzhelian rotation linked to an important reactivation of previously formed N-S oriented structures and the formation of radial folds and E-W oriented thrusts in the core of the arc (Weil et al. 200, 2001, 2010, 2012 and 2013). However, the results of the southern arm are more difficult to interpret. According to Pastor-Galán et al (2015a, 2016 and 2017) and Fernández Lozano et al. (2016) paleomagnetic declination vectors exhibit a wide dispersion, ranging from 60° (Fernández Lozano et al. 2016) to 90° (Pastor-Galán et al. 2017). Moreover, results obtained differ, depending on the type of analysed lithologies. These authors attribute the results to a remagnetization synchronous with the formation of the arc (Late Kasimovian-Early Permian). This interpretation has some important consequences: a) it implies that remagnetization processes were active for a long time interval (ca. 13 my, 310-297 Ma) in the southern branch of the arc, b) it implies a different timing for the remagnetization in the northern arm and in the core (previous to the arc formation), compared to the southern arm (synchronous with the arc formation), and c) it imposes a different kinematics for the formation of the arc, as in its northern arm the arc form as a result of 25° clockwise rotation, whereas in the southern arm a counter-clockwise rotation ranging from 70-90° is required (Pastor-Galán et al. 2015a, 2016 and 2017; Fernández Lozano et al. 2016). A closer view of the paleomagnetic results suggests that although this dispersion exists, when the data are considered grouped in their sites, the dispersion may be minimized. For instance, in Fig. 6 of Pastor-Galán et al (2017) the dispersion of the mean values of the sites is around 40°. Moreover, the deviation of the mean value of all the obtained vectors (138°/12.5°) from the Early Permian reference declination orientation (158°) is only ca. 20° (Figs. 8 and 12, Pastor-Galán et al. 2017).

2) In our opinion the most important point is that the paleomagnetic results of this south-

ern arm are not in accordance with regional geology data. Proposed counter-clockwise vertical axis rotations ranging from 70-90° implies shortening of several hundreds of kilometres and internal deformation in the southern arm of the arc to acquire an isoclinal fold geometry from an initial arc formed by tangential longitudinal strain (Weil at al. 2013). However, as we discuss in our contribution, no deformational structures accounting for these deformations are described, the remagnetization is post-Variscan folding (Pastor-Galán et al. 2015a, 2016), and these areas are characterized by simple structures with open upright folds and gently plunging fold axes (Pastor-Galán et al. 2016). Such simple structural arrangement allows Pastor-Galán et al. (2017) to discard structural complexities as the main source of scatter of the declination vectors in the southern arm of the arc. It should be noted, however, that the discrepancy between regional and paleomagnetic data is not discussed in paleomagnetic papers dealing with the southern arm of the arc. As our starting point is different, from regional geology data, we cannot use paleomagnetic data that are not in accordance with the regional data, to constrain our proposed reconstruction.

We are conscious that a detailed discussion of the points outlined above is beyond the scope of this paper. In future contributions, we intend to discuss in detail various aspects of this complex geology.

Best regards,

Josep Maria Casas

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