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# Serpentinization and magmatic distribution in a hyperextended rift suture revealed by joint gravimetric and magnetic geophysical forward modelling (Mauléon basin, Pyrenees)

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## Résumé

The Mauléon basin, in the Pyrenean realm, is a world-class example of hyperextended rift suture. It first develops during the Early Cretaceous. Then, this domain subsequently underwent tectonic inversion, and subcontinental mantle remains preserved at shallow depth. The structural architecture of the Mauléon pop-up is controlled by the coeval development of N120° thrust systems and N20° transfer zones. The basin possesses key attributes of an optimal hydrogen target, namely serpentinized mantle, at shallow depth with tectonic structures deeply rooted into it. Actually, natural H<sub>2</sub> seepages have been recognized at the surface in the foothills. Yet the distribution of the serpentinization within the mantle piece representing the potential main H<sub>2</sub> source has not been addressed while this aspect is crucial to consider further exploration. We here discuss the spatial distribution of the serpentinization using joint gravimetric and magnetic 2D forward modelling along two orthogonal transects through the main gravimetric and magnetic anomalies. 2D forward modelling shows that serpentinization gradually increases from bottom to top (20km to 8km depth). The N-S transect evidence that serpentinization fronts are northward inclined, suggesting a N-S serpentinization gradient along a N120° striking front responsible for the main gravity and magnetic anomalies recognized in the basin. This orientation matches that of detachment within the former hyperextended domain, which exhumed the mantle rock during the Cretaceous. The W-E transect shows that the amount of serpentinization differs between lithospheric compartments delimited by the transfer zones indicating that the hyperextended domain was segmented conditioning a W-E serpentinisation gradient. Finally, the easternmost Barlanès transfer zones coincide with the main magnetic anomaly recognized in the basin. The latter being shifted from the regional Bouguer anomaly, the mantle can't be its source. Forward modelling reveals that this anomaly could be linked to the presence, at shallow depth, of an alkaline magmatic intrusion attesting for the paroxysm of the rifting phase. This interpretation is consistent with surface observations suggesting that mantle denudation is fully achieved in this part of the basin since mantle rocks were reworked in the Urdach syn-rift sequence upon this transfer zone.

**Mots-Clés:** Serpentinisation, Hyperextended rift, Transfer zones, hydrogen, Pyrenees, Mauléon basin

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