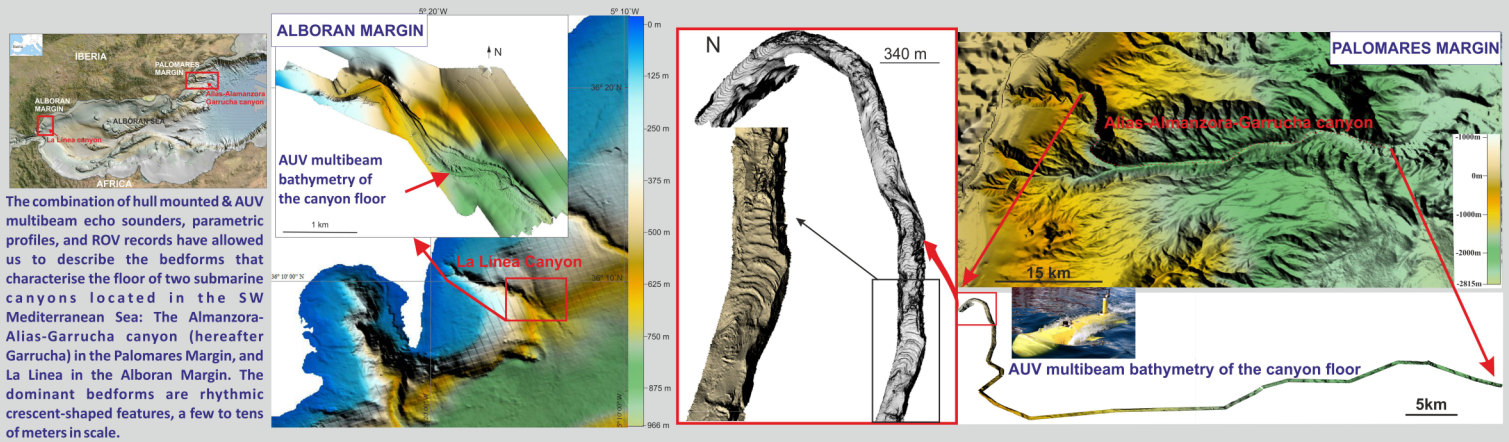


# Bedforms and sedimentary processes along the Garrucha and La Linea canyon axis (SW Mediterranean Sea)

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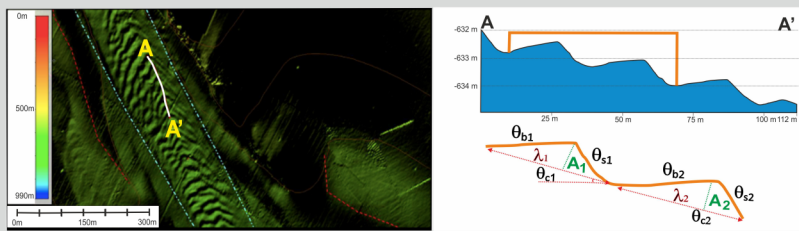
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## Location and methods



The combination of hull mounted & AUV multibeam echo sounders, parametric profiles, and ROV records have allowed us to describe the bedforms that characterise the floor of two submarine canyons located in the SW Mediterranean Sea: The Almazora- Alias-Garrucha canyon (hereafter Garrucha) in the Palomares Margin, and La Linea in the Alboran Margin. The dominant bedforms are rhythmic crescent-shaped features, a few to tens of meters in scale.

## Analysis of crescent-shaped bedforms



GARRUCHA	Minimum	Maximum	Average
θc (°)	0.23	8.21	4.33
θb (°)	0.06	5.56	1.18
θs (°)	1.36	13.46	5.37
λ (m)	11.11	98.56	43.28
A (m)	1.37	19.03	4.33
WD(m)	1070	1875	1387

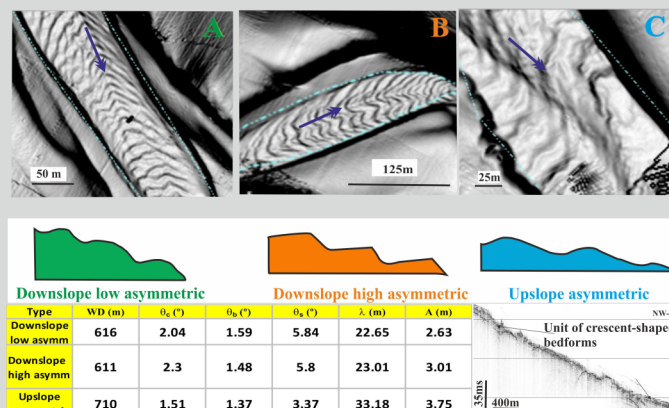
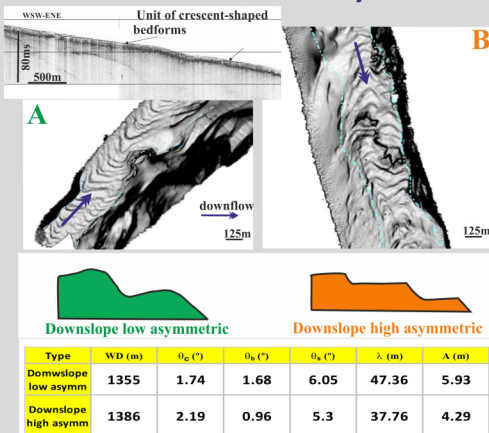
  

LA LINEA	Minimum	Maximum	Average
θc (°)	0.43	5.03	2.27
θb (°)	0.04	2.88	1.52
θs (°)	1.7	11.08	5.78
λ (m)	10.13	48.81	23.6
A (m)	0.67	12.91	2.86
WD(m)	541	712	619

A total of 146 crescent-shaped features have been mapped in the Almazora- Alias-Garrucha canyon and 106 in La Linea canyon. The asymmetry cross-section shape has been considered the criteria for characterization of types: low upslope low asymmetric; upslope high asymmetric and downslope asymmetric. The morphometric analysis of each type has involved the measurement of the following parameters: water depth (WD), axial gradient (θc), stoss side gradient (θs), lee side gradient (θl) and wave amplitude (A). Correlation analysis was run with the resulting data using the XSLAT software.

## Garrucha canyon

## La Linea canyon



### SIMILARITIES

- \* The downslope asymmetric bedforms are dominant.
- \* The axial gradients seem to condition the distribution of the bedforms and asymmetry: the downslope low asymmetries are commonly observed on higher axial gradients.
- \* The axial and lee side gradients show correlation (coefficient: 0.53 to 0.91).
- \* The wave amplitude shows good correlation with wavelength (coefficient: 0.62 to 0.91).
- \* The lee side gradients are steeper than the stoss side, which can be relatively flat.
- \* The lee and stoss side gradients correlate (coefficient: 0.46 to 0.56) for the downslope low asymmetric bedforms.
- \* Bedforms form about a 10 ms thick transparent unit with hyperbolic echoes that rests over an irregular high reflectivity surface.

### DIFFERENCES

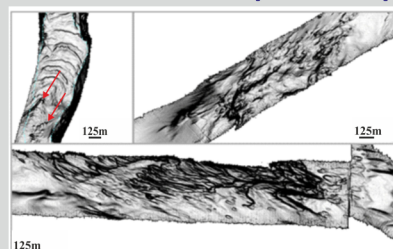
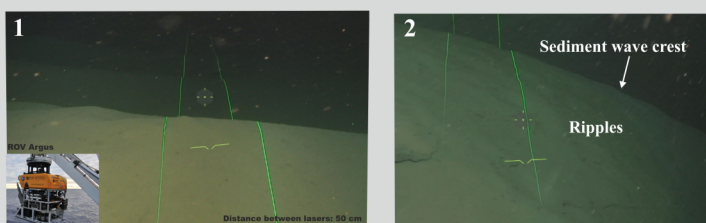
- \* The upslope asymmetric bedforms, that are much fewer, are absent in the Garrucha canyon. They occur where the axial gradients are lower.

The crescent-shape in plain view with their crests curving downslope toward the talweg margins, their step-like morphology in cross-section with the lee sides steeper than the stoss sides, the results of the morphometric and acoustic analysis and the lack of morphological evidences of sedimentary instability features, all together suggest that our bedforms are similar to other ones in canyon floors characterized as cyclic-steps. Then, they would be formed by supercritical density flows; in fact, the measured axial gradients of both canyons are steep enough to generate those flows. The supercritical density flows would be mainly related to the rivers/streams floods favoured by the proximity of the canyon heads to the coast and erosion of canyon margins. The spatial variability of the cyclic steps in each canyon could respond to the coexistence of modern/subrecent bedforms with deepest ones probably formed during the last period of low sea level.

## Other bedforms

### Superimposed sediment waves

### Spoon-shaped scours



The spoon-shaped scours are metric features locally mapped along the talweg of the Garrucha canyon, from 1121 to 2425 m water depth. They have the tendency to coalesce, creating areas of erosion. They have asymmetric V profile with the steepest and shortest side facing downslope. Its plan view morphology varies from semicircular to semicircular-elongated. They are highly variable in length, 30 m to > 400 m. They occur/define abrupt changes in the general gradient of the canyon axis, with increments of up to 4°.

Images from the ROV Argus crossing the cyclic steps. They show metric sediment waves (1) with superimposed ripples (2) on their flanks; the first ones seem to be superimposed on the larger cyclic steps. This points to variable sedimentary and hydrodynamic processes, although the temporal scale is unknown.

