Onshore study of syn-orogenic olistostromic deposits in the Gibraltar Arc: a tool to reveal mountain front uplift

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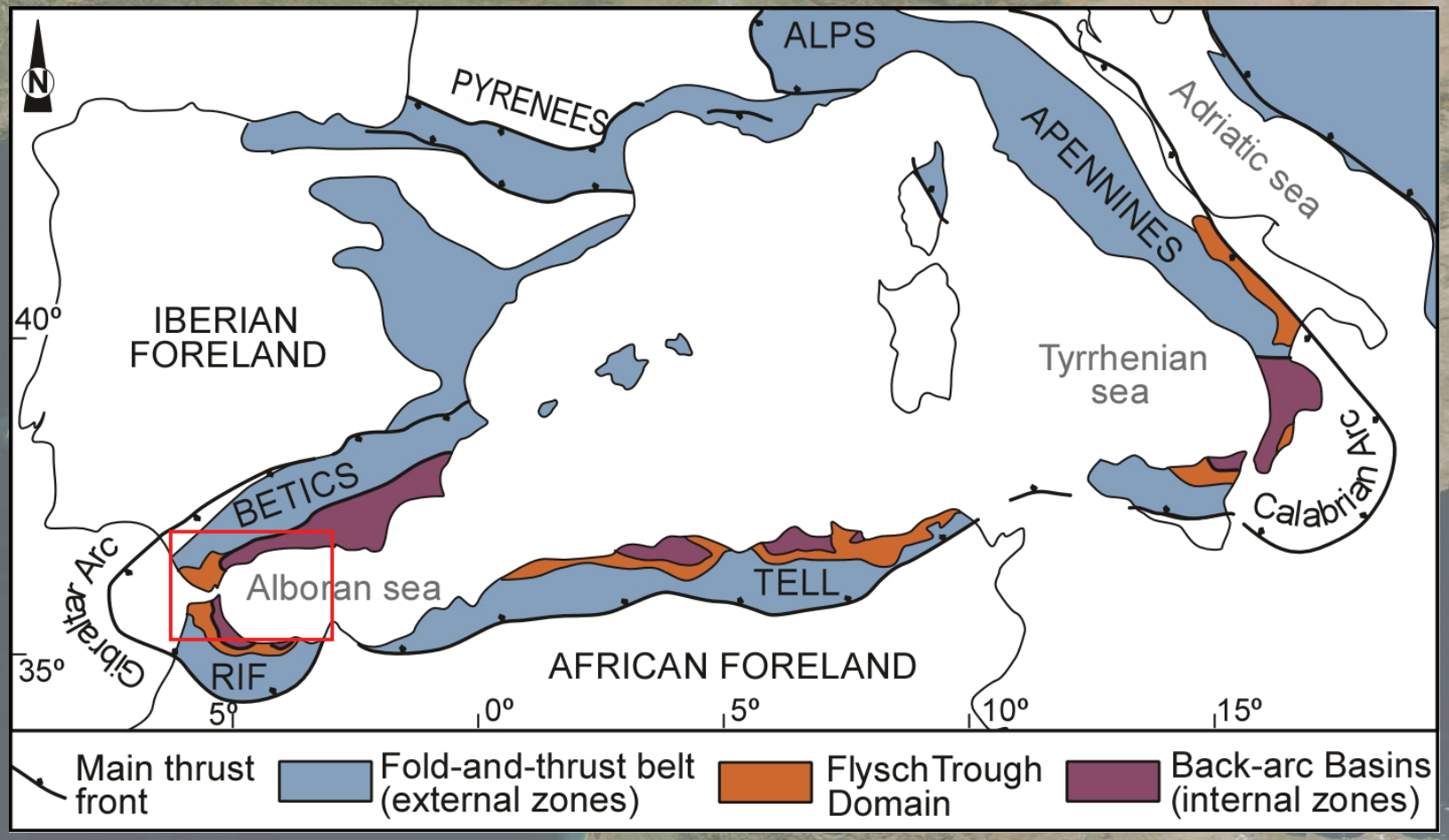
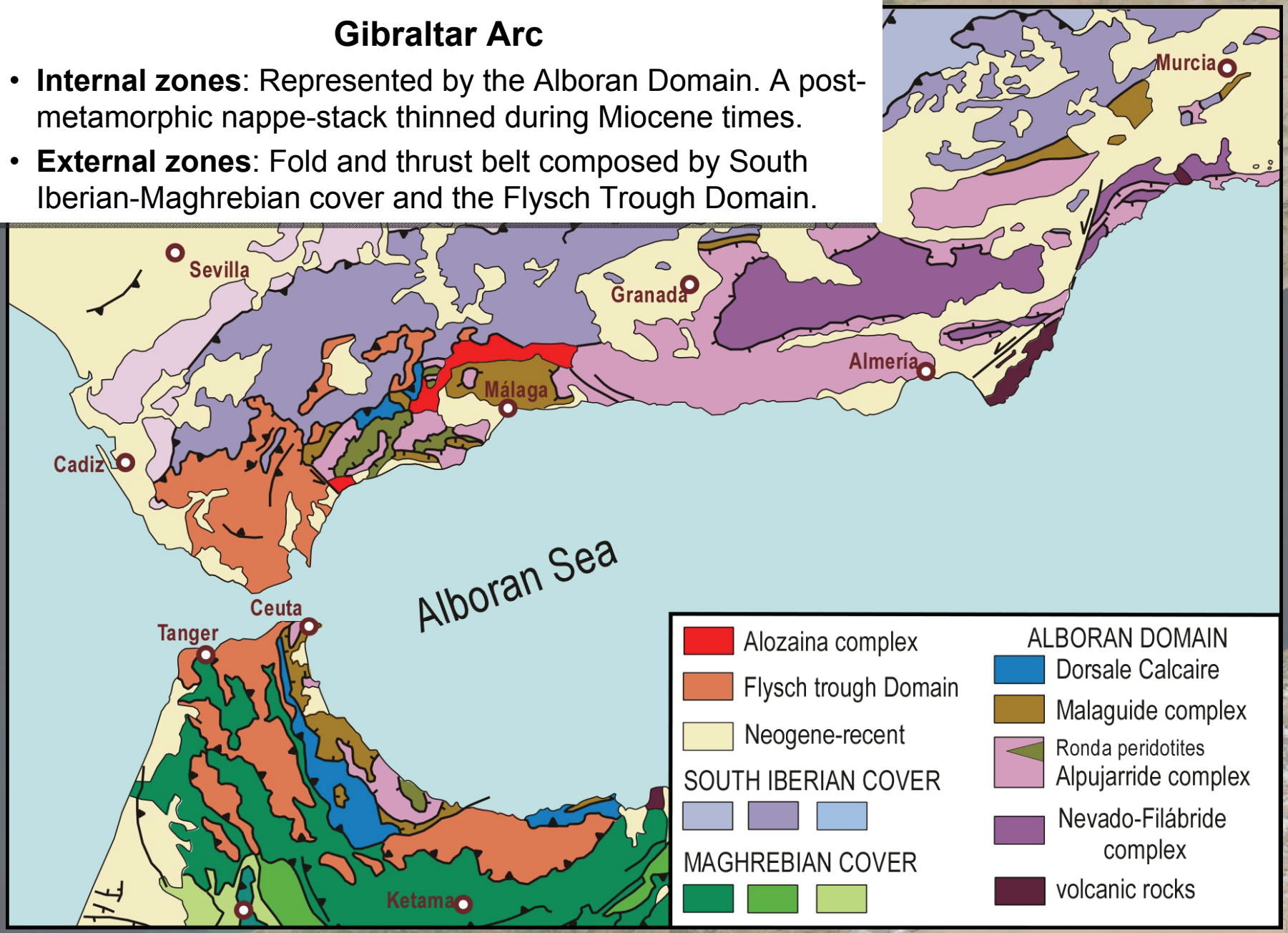


Modified from Crespo-Blanc and Frizon de Lamotte (2006) *B. Soc. Geol. Fr.*

- Western Mediterranean Alpine orogens.
  - Arc-shape geometry.
  - Fold-and-thrust belts developed in the external zones.
  - Back-arc basins over the internal zones.
  - Formation of accretionary prism (Flysch Trough Domain) along the internal-external zone boundary.

Gibraltar Arc

- **Internal zones**: Represented by the Alboran Domain. A post-metamorphic nappe-stack thinned during Miocene times.
- **External zones**: Fold and thrust belt composed by South Iberian-Maghrebian cover and the Flysch Trough Domain.



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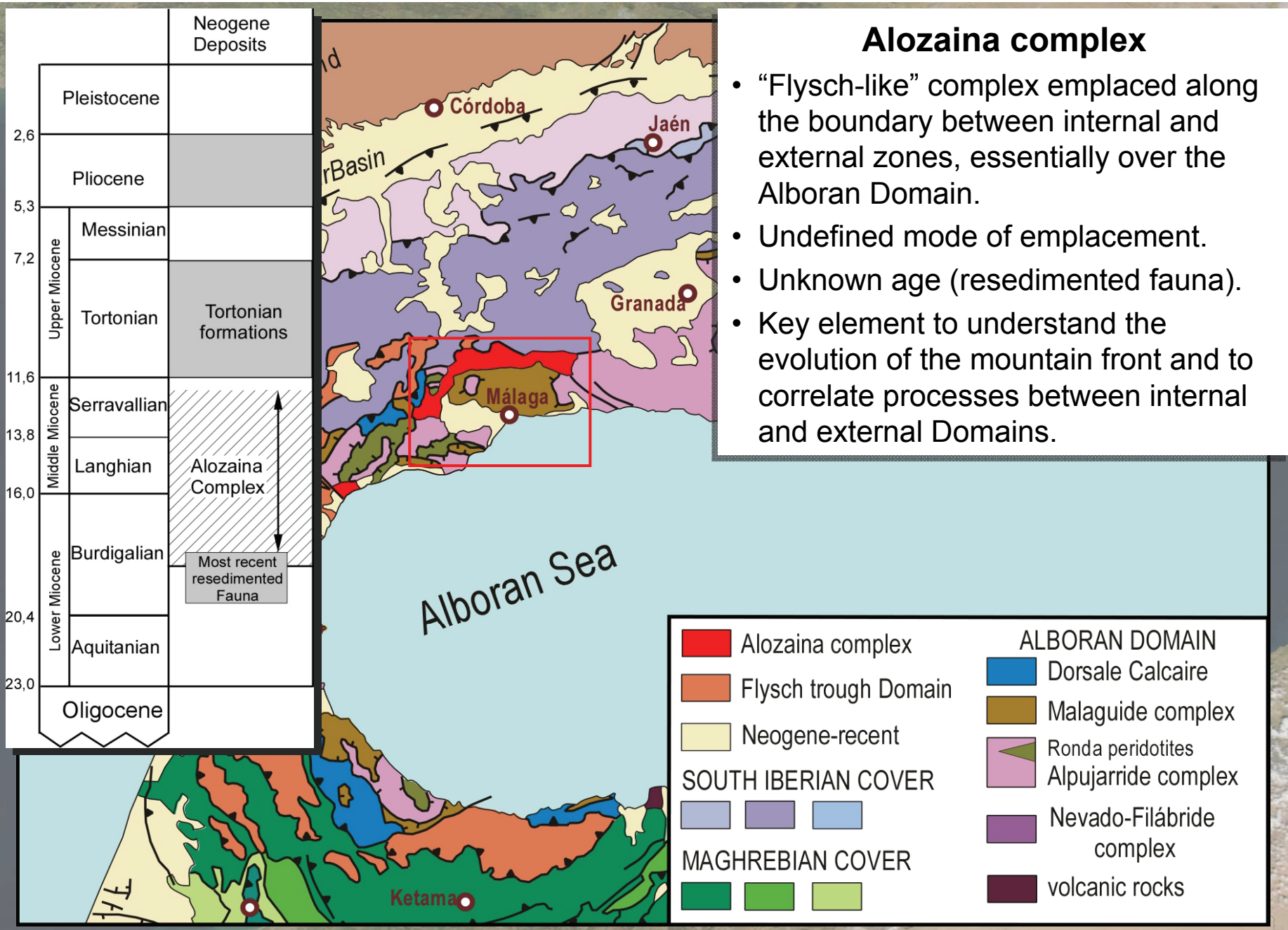
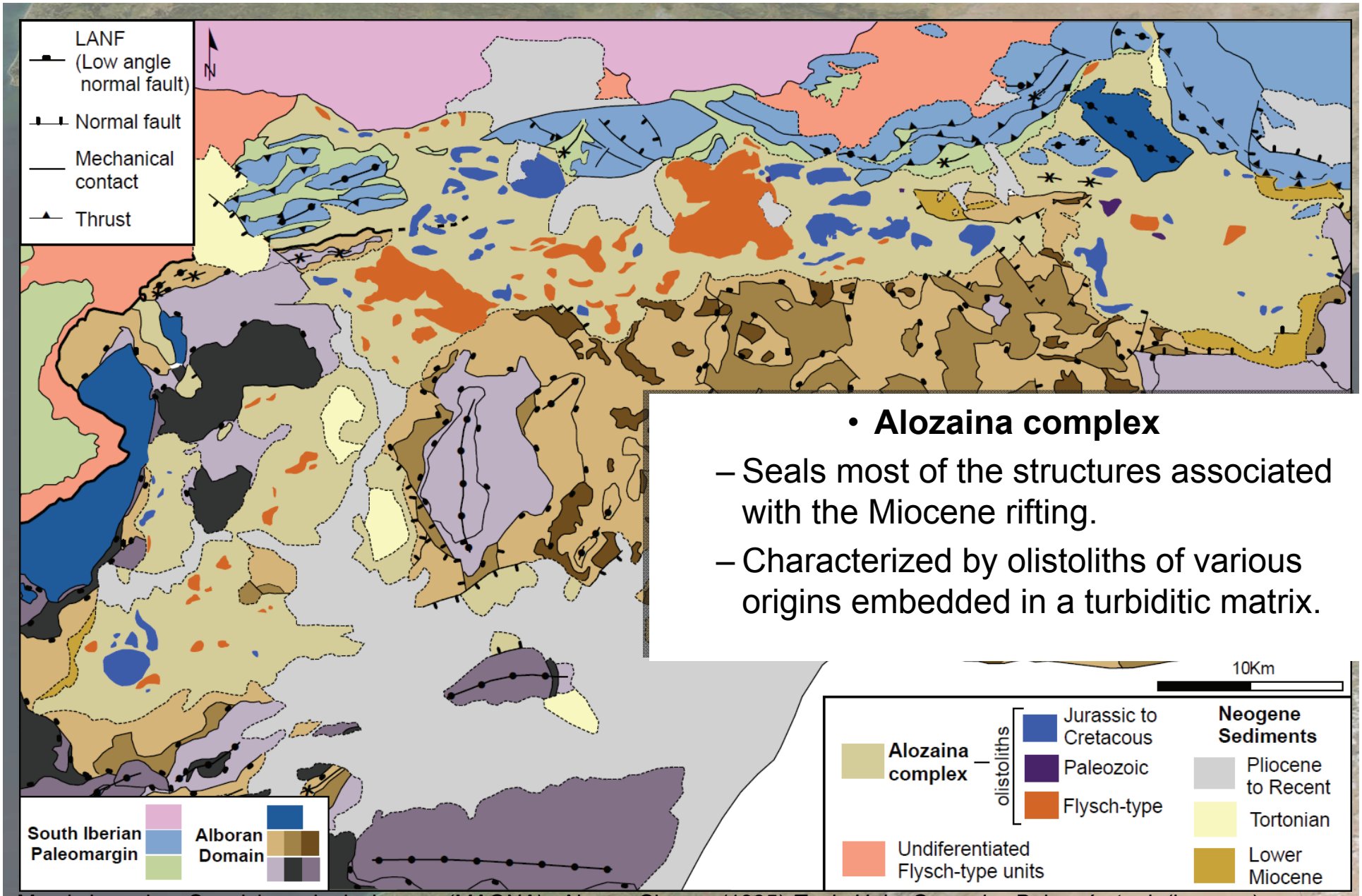


Alozaina complex

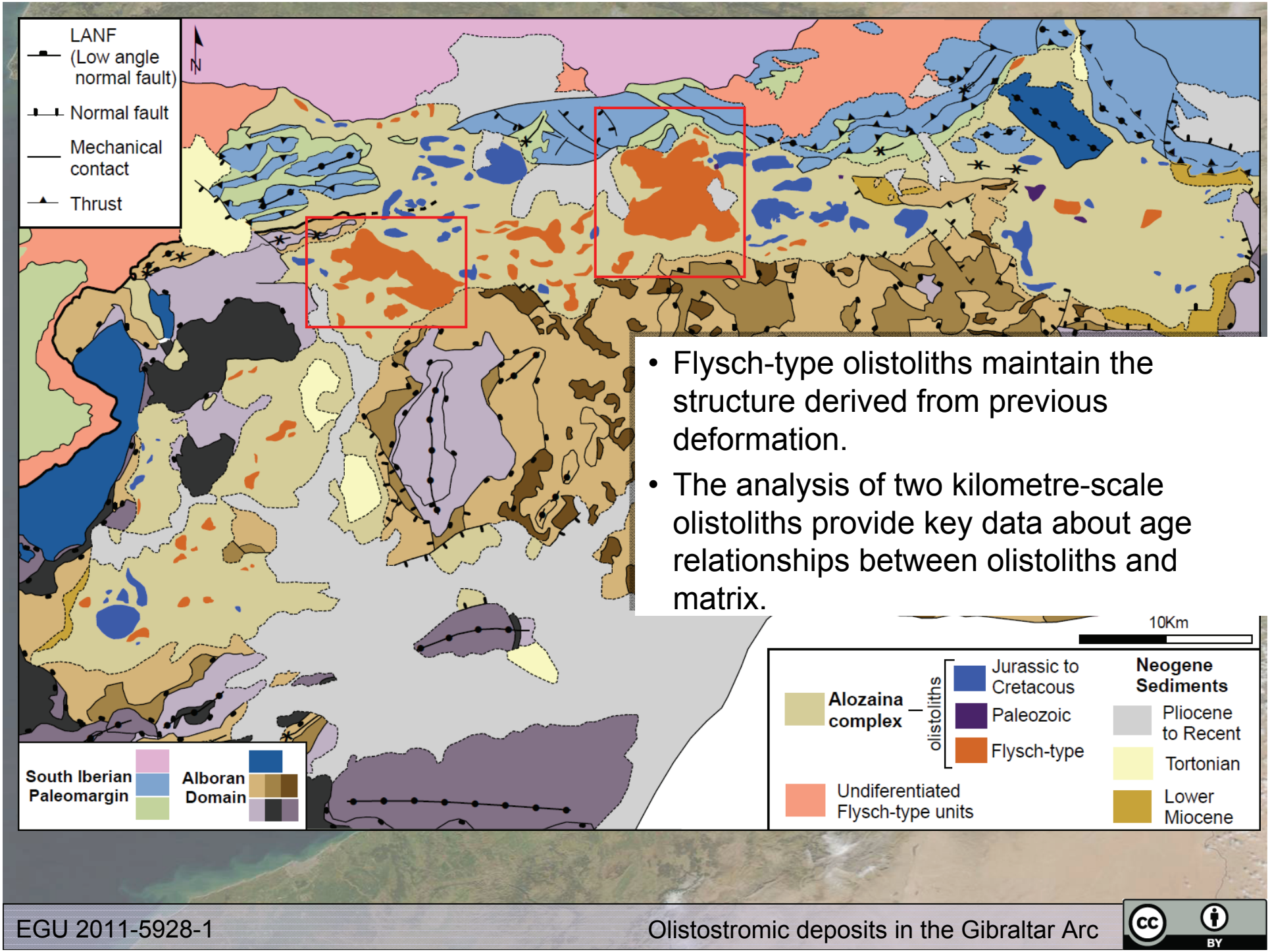
- "Flysch-like" complex emplaced along the boundary between internal and external zones, essentially over the Alboran Domain.
- Undefined mode of emplacement.
- Unknown age (resedimented fauna).
- Key element to understand the evolution of the mountain front and to correlate processes between internal and external Domains.



- **Alozaina complex**
  - Seals most of the structures associated with the Miocene rifting.
  - Characterized by olistoliths of various origins embedded in a turbiditic matrix.

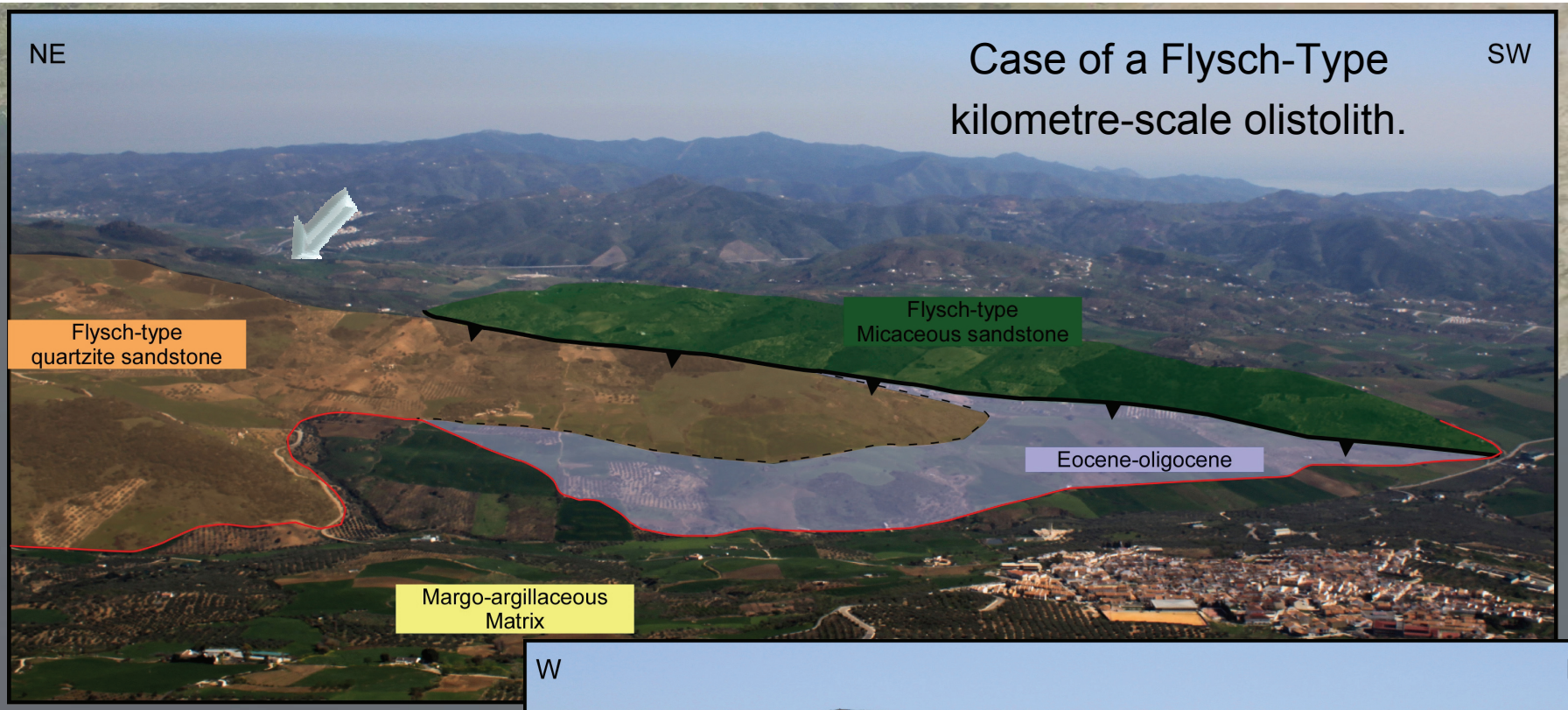
Map is based on Spanish geological maps *(MAGNA)*., Alonso-Chaves (1995) *Tesis Univ. Granada*., Balanyá et. al. (in press) *Geologica Acta*., Booth-Rea et. al. (2003) *CR. Geoscience.*, Sanchez-Gomez (1996) *Tesis Univ. Granada*.

- Olistoliths can be classify in three groups:
  - Flysch-type rocks.
  - Jurassic to Cretaceous carbonate rocks.
  - Palaeozoic rocks, which derive from the nearby Alboran Domain.

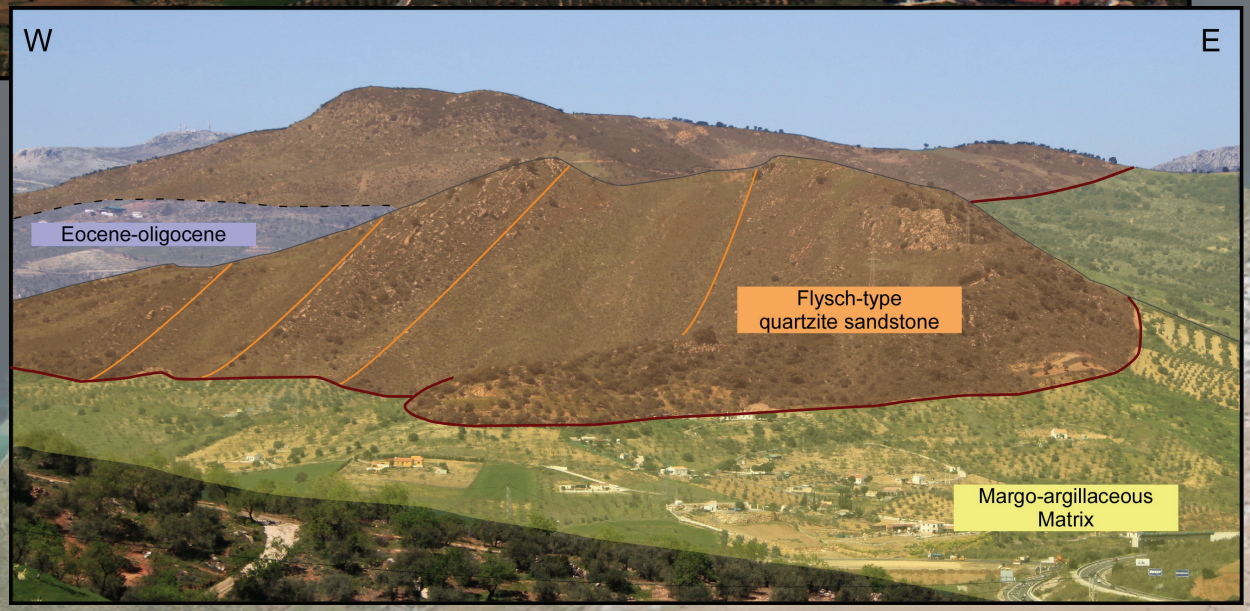


- Flysch-type olistoliths maintain the structure derived from previous deformation.
- The analysis of two kilometre-scale olistoliths provide key data about age relationships between olistoliths and matrix.

Case of a Flysch-Type kilometre-scale olistolith.



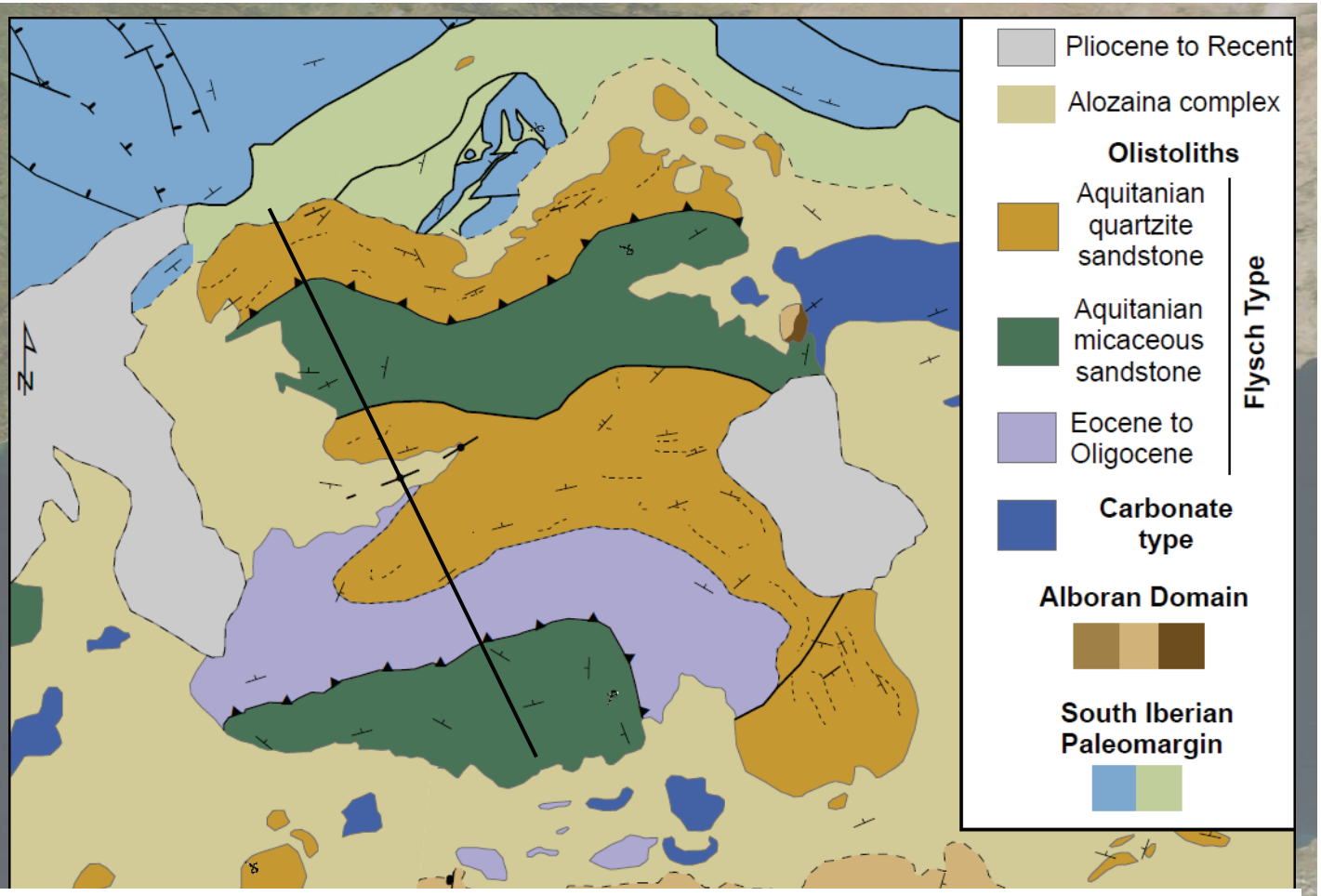
- Formed by various slices which belong to different lithostra-tigraphic units.
- A near horizontal surface cuts the base of the structured olistolith.

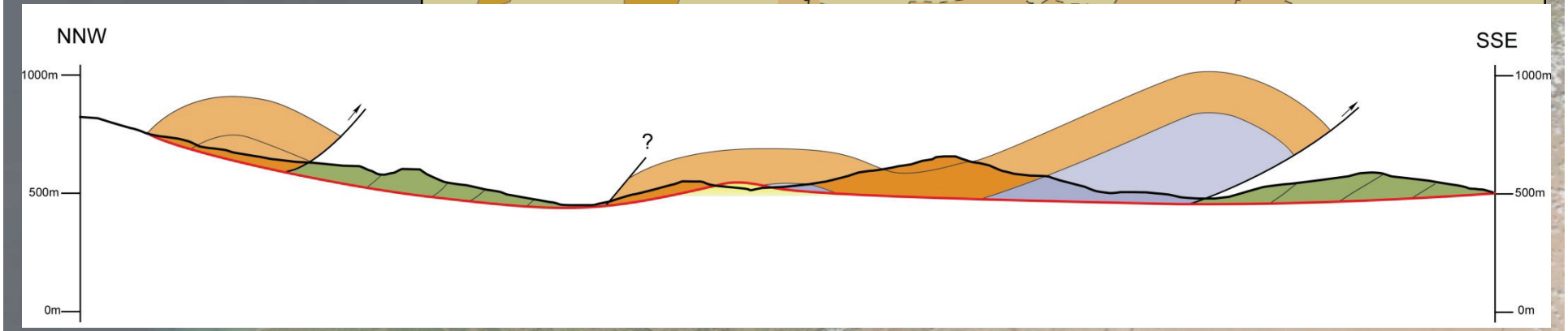


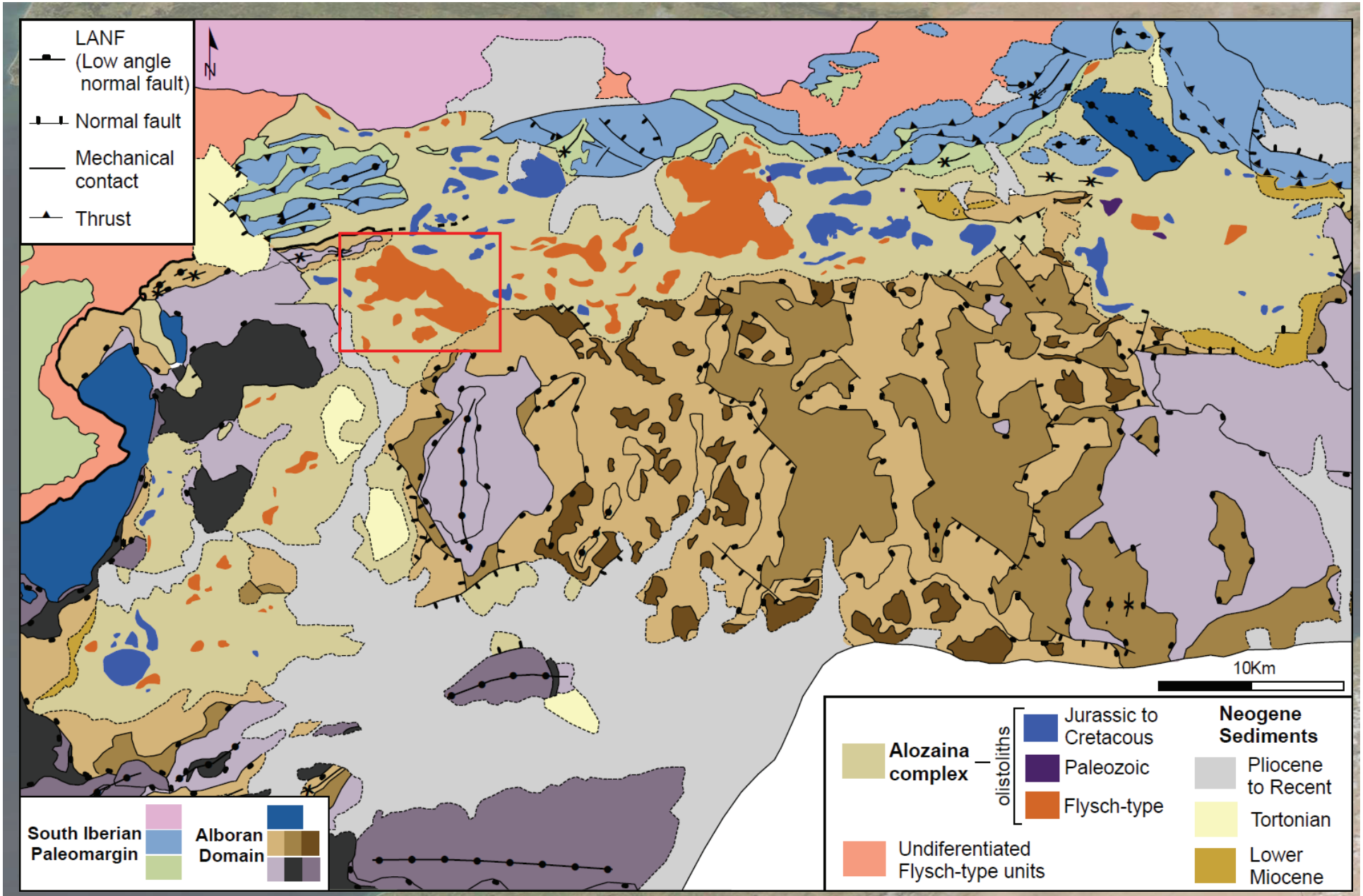
- **Flysch-type olistolith main features**

- Imbricate thrust sequence: S-vergent and arcuate geometry (NNW- to NE-directed).
- Age range of the sequences: Eocene-Oligocene to Aquitanian.

Modified from Spanish geological maps *(MAGNA)*



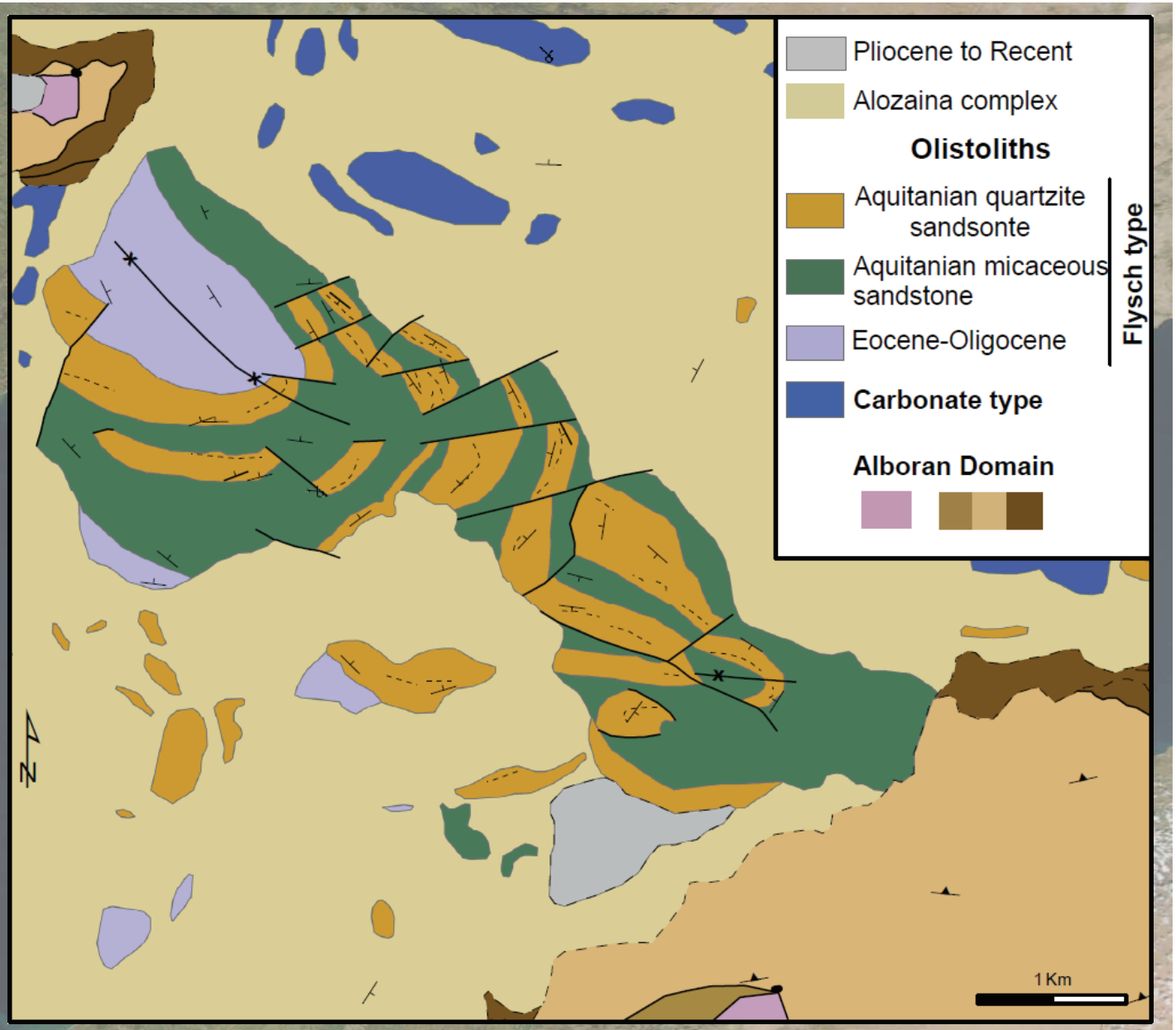



LANF
(Low angle
normal fault)
Normal fault
Mechanical
contact
Thrust
N
10Km
South Iberian
Paleomargin
Alboran
Domain
Alozaina
complex
olistoliths
Jurassic to
Cretacous
Paleozoic
Flysch-type
Undiferentiated
Flysch-type units
Neogene
Sediments
Pliocene
to Recent
Tortonian
Lower
Miocene

- **Flysch-type olistolith main features**

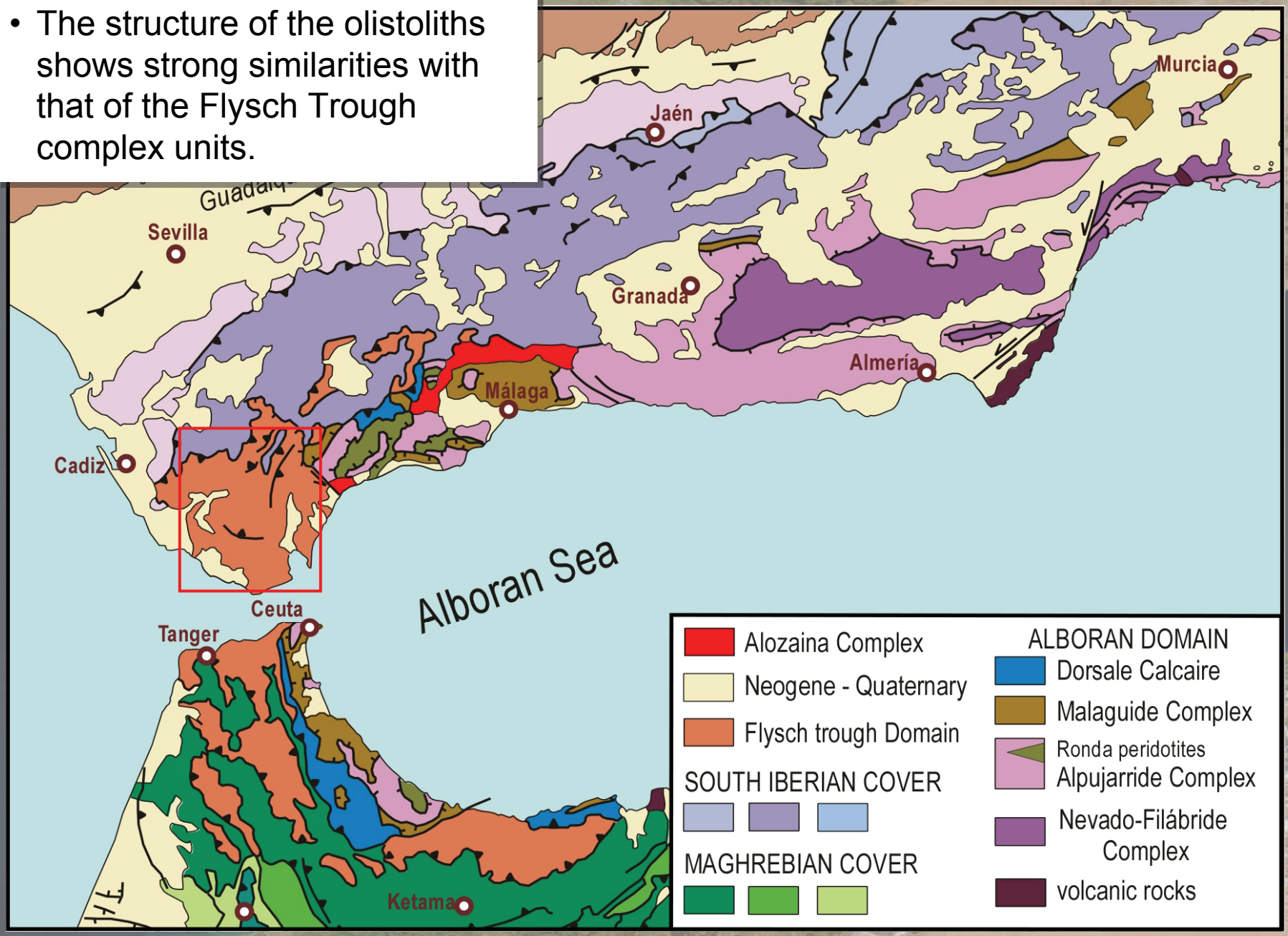
- Alternating of quartzitic and micaceous rocks (hectometric bedding, Aquitanian in age).

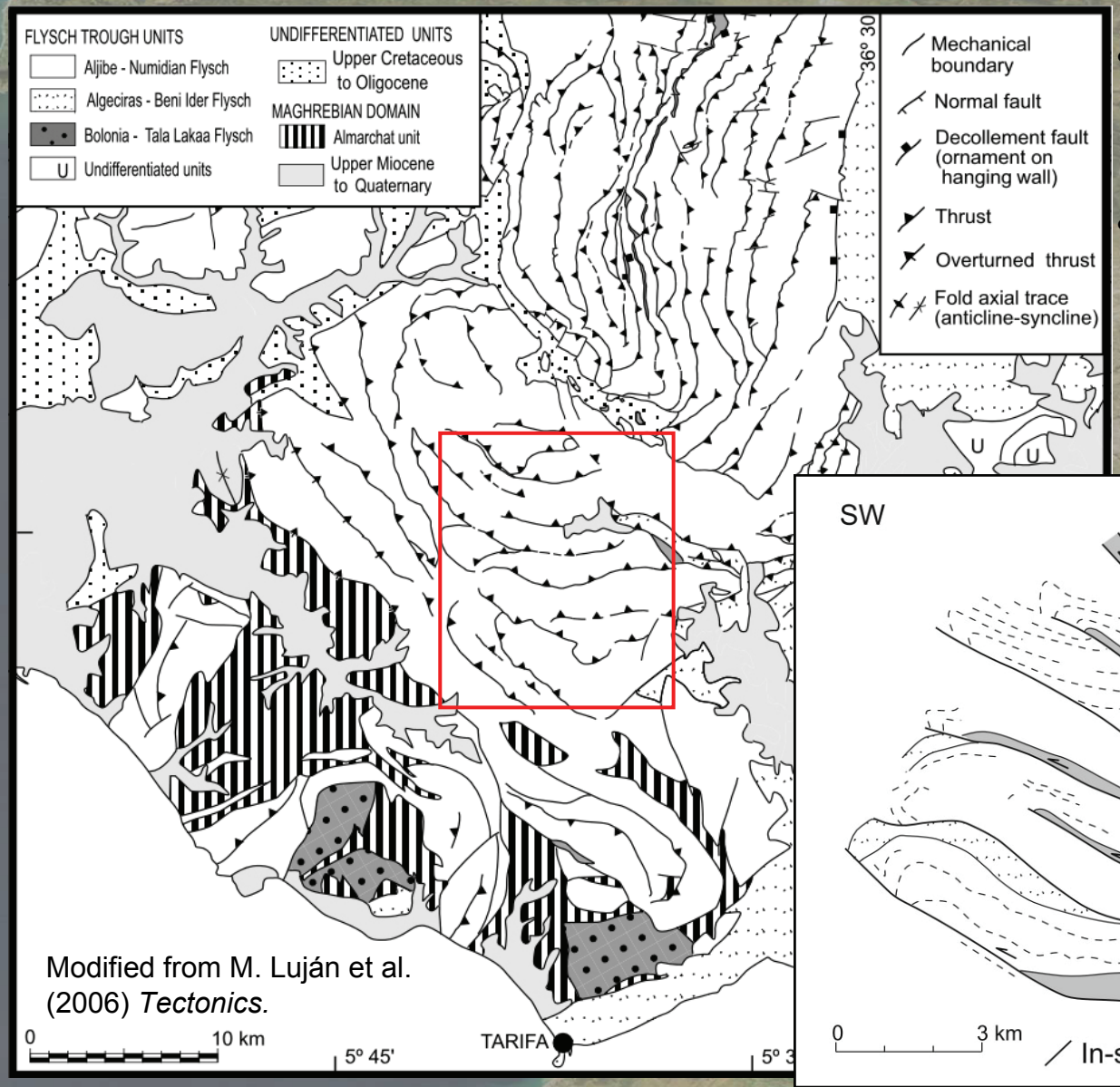
- Structure of the olistolith: closed synform.



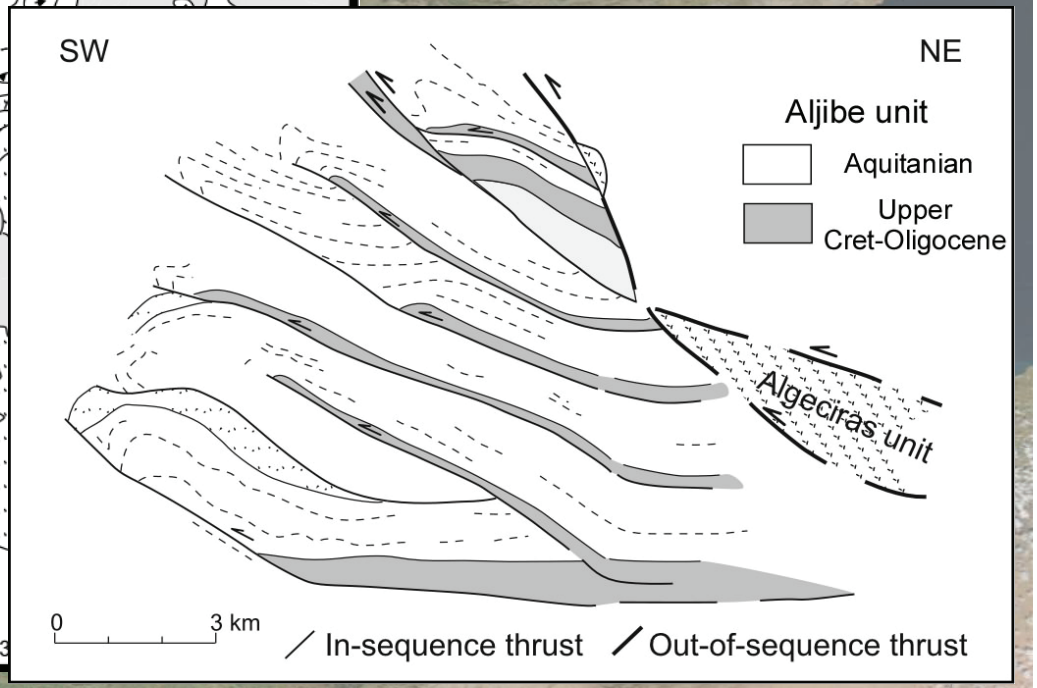
Modified from Spanish geological maps *(MAGNA)*

- The structure of the olistoliths shows strong similarities with that of the Flysch Trough complex units.

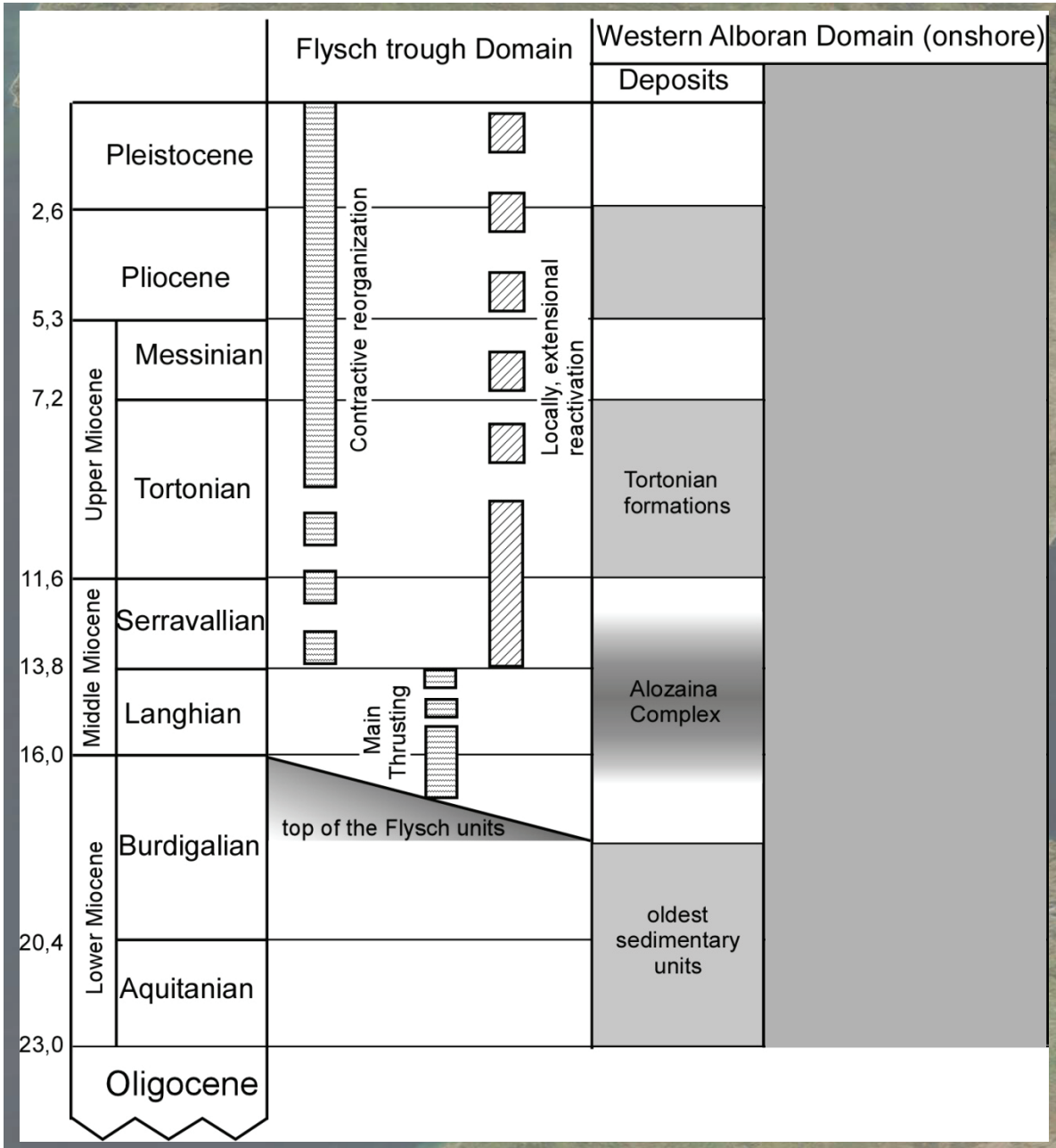




- It is also structured as an imbricate thrust and fold belt.
- Thrusts involve units mainly from Paleogene to Aquitanian sandstone formations.

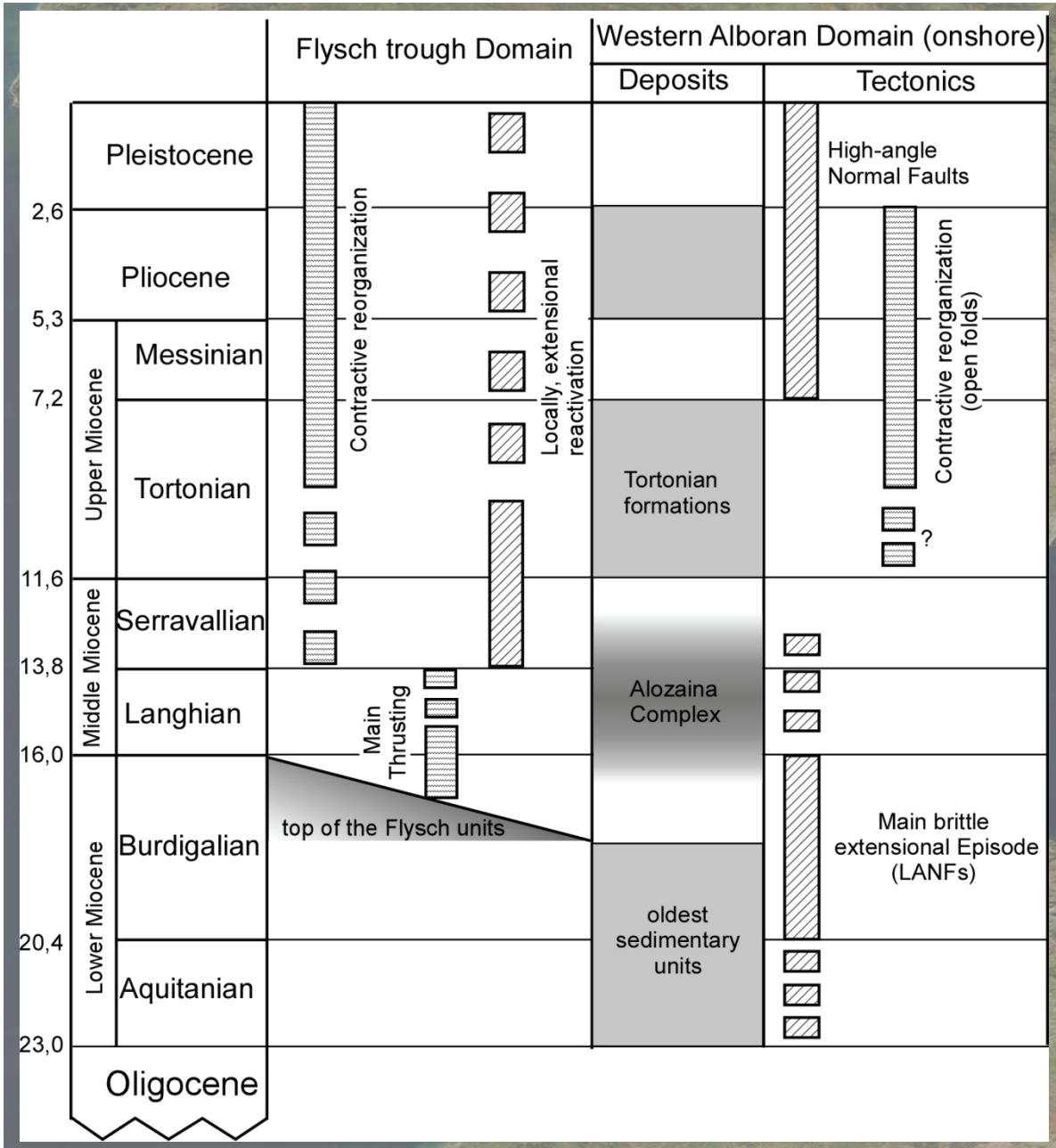


- Lithological correlation between the olistoliths from Alozaina complex and the Flysch Trough units can be established.



- Flysch-type olistoliths from Alozaina complex derive from an already structured and uplifted Flysch Trough Domain.
- Olistoliths of various provenance (internal and external zones).
  - → The Alozaina complex results from the gravitational dismantling of the already structured units situated along the internal-external zone boundary.
  - → The deposition of the Alozaina complex had to occurred from Langhian to Serravalian times.

Ages according to de-Capoa et. al. (2007) *CR. Geoscience*., Crespo-Blanc et. al. (2007) *Rev. Soc. Geol. Esp*., Esteras et. al. (1995) *oral communication, Sevilla*., Lopez-Garrido & Sanz de Galdeano (1999) *J. Petrol. Geol*., Serrano et. al. (2007) *Geobios*.

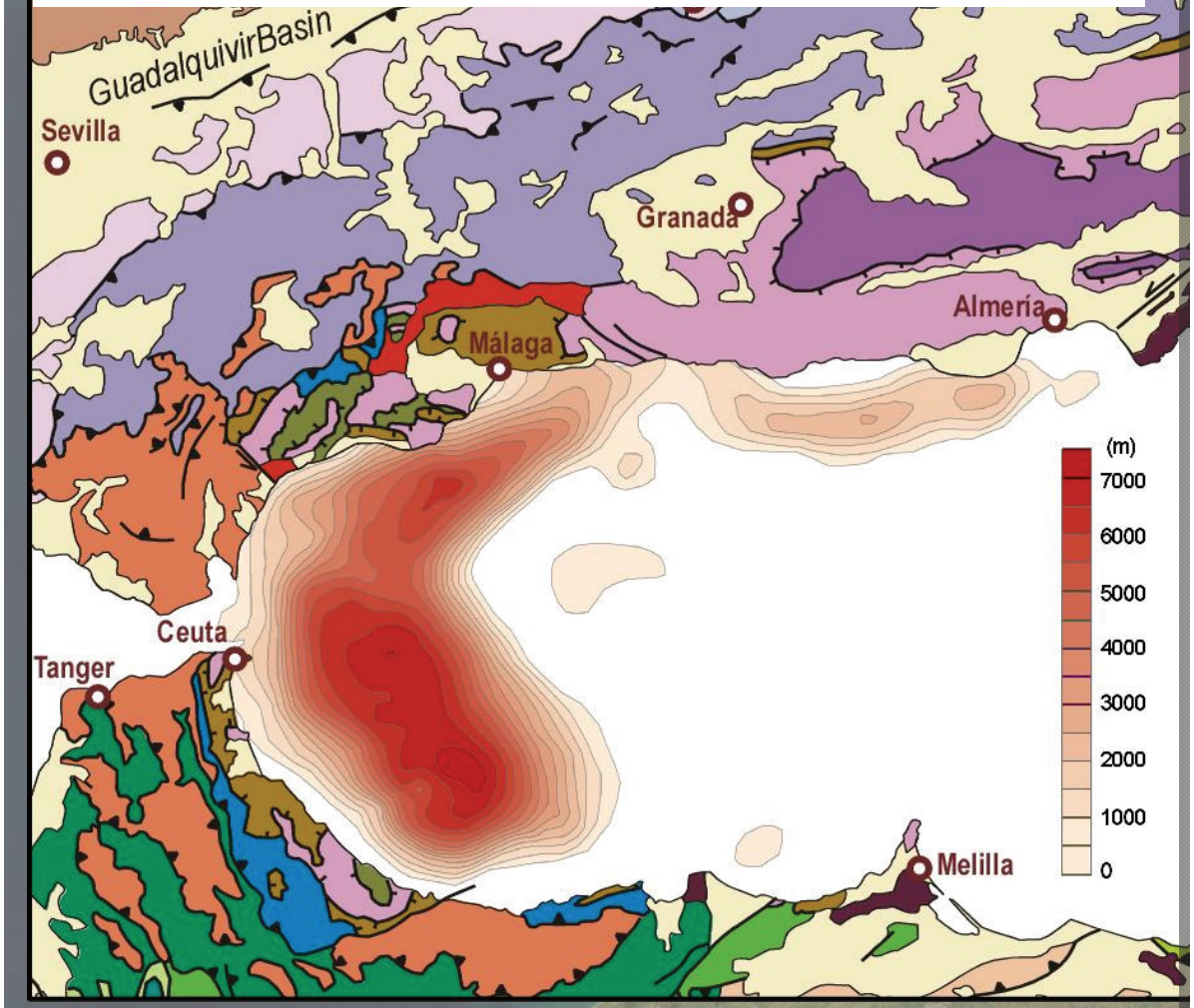


- **Regional implications**
- Triggering of the gravitational dismantling was more likely helped by:
  - Fast uplift of the mountain front.
  - Extensional tectonics in the Alboran Domain.
- In the western Alboran Domain, extension associated with Miocene rifting can not extend beyond the deposition of the Alozaina complex, at least onshore.
- The Alozaina olistostromic complex represents a late stage of the Alboran Domain rifting.

Alboran Domain tectonics according to Garcia-Dueñas et. al. (1992) *Geo-Marine Letters*.

Isopach map of Lower to Middle Miocene Deposits on the Alboran Sea.

Modified from L. Iribarren et al. (2009) *Tectonophysics.*



- **Regional implications**
- Offshore, the western Alboran Domain shows a thick sedimentary sequence from Lower to Middle Miocene.
- The Alozaina complex can most likely be correlated with part of this sedimentary sequence.
  - → Erosion of the already uplifted mountain front was coetaneous with large subsidence at the Alboran Domain.
  - → Very important vertical movements took place in the Gibraltar Arc orogenic system, at least during Middle Miocene times.