Distribution and Significance of Tectonic Patterns in

ARGADNEL REGIO, EUROPA

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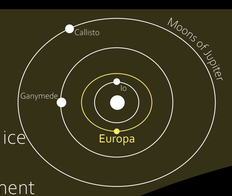
BACKGROUND



Europa, an icy moon of Jupiter, is **heavily tectonically deformed** due to various potential **global-scale stresses** including diurnal tides, nonsynchronous rotation, true polar wander, and ice shell thickening.[1] Additionally, Europa's **surface is only ~90 million years old**, one of the **youngest** surfaces in the solar system.[7] **Dilational bands**, associated with the emplacement of **new surface material** similar to Earth's mid-ocean ridges,[1-6] may play an important part in **resurfacing** Europa and may be responsible for **Europa's uniquely young surface age**.[7]

While d**ilational bands may be responsible for the creation of new surface material**, a large-scale **mechanism compensating for this new material** is necessary to maintain a **constant surface area balance**, assuming that Europa's size has remained the same over time.[8-9]

One hypothesis suggests that **subduction** may be responsible for **recycling large swaths of Europa's icy crust into the subsurface**. The surface expression of subduction on Europa may be represented by **subsumption bands** across which linear geologic features are **discontinuous** and the potential overriding plate has **cryovolcanic** materials.[10]

To further investigate the role that **plate tectonics** play in **recycling Europa's icy crust**, we present the beginning of a detailed investigation of **broad-scale, brittle deformation** patterns that supply evidence of **plate-like motions**. This study places a particular focus on the **highly fragmented Argadnel Regio** and its surrounding regions.

GEOLOGIC CONTEXT

Argadnel Regio, outlined by the white rectangle on the globe to the right, is arguably **Europa's most enigmatic geologic region.** The intense fragmentation of this **swath of deformation**, at the global and local scale, suggests a **complex tectonic history.** Previous work[2] elaborates on the pervasiveness of **wedge-shaped dilational bands** in Argadnel that supply evidence for **an ample amount of extension in this region** of Europa.

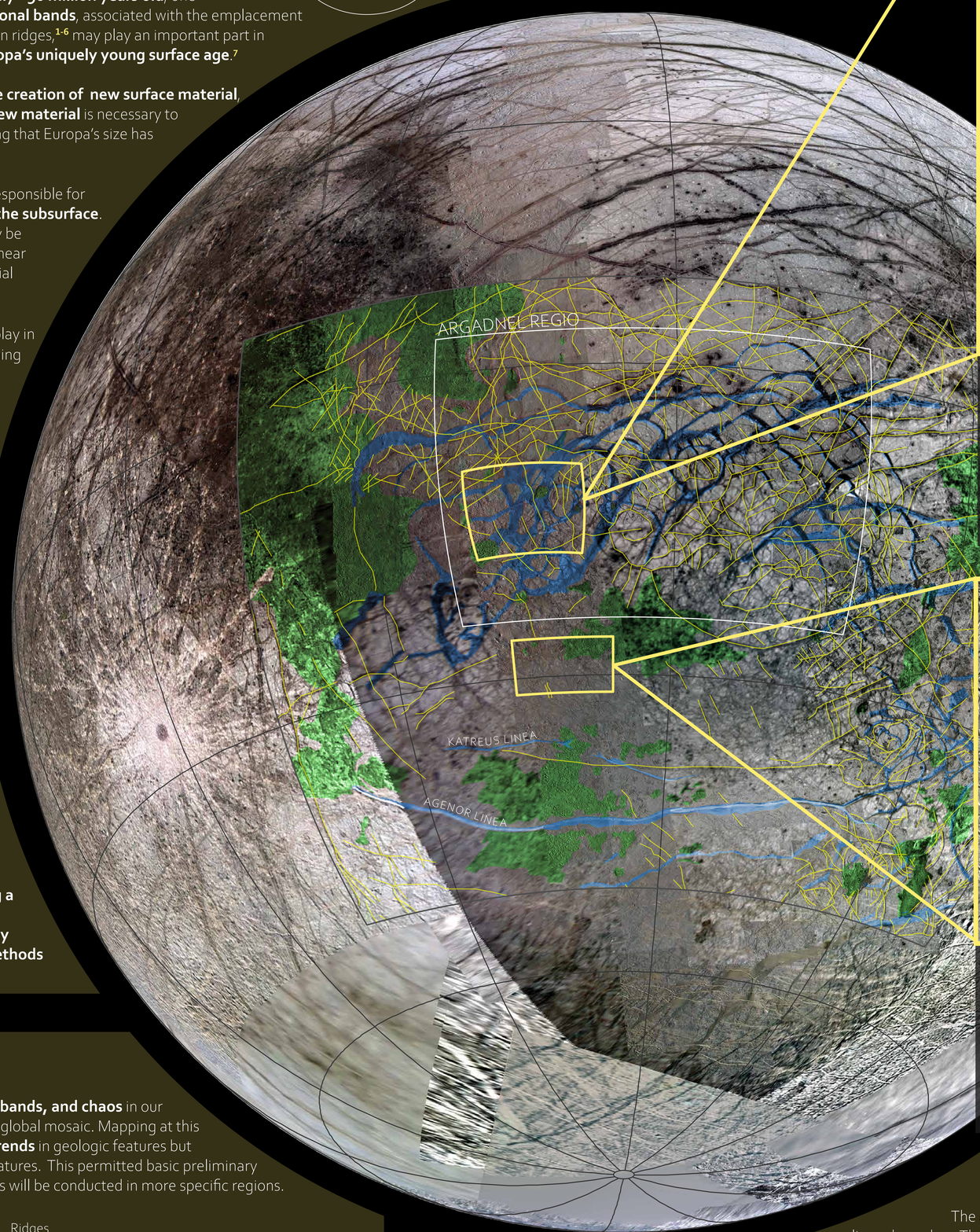
To the **South of Argadnel**, the pervasiveness of extensional features appears to **abruptly halt along a discrete boundary.** What controls this boundary is unknown, but our mapping seeks to characterize **why these two regions have such starkly different methods of deformation.**

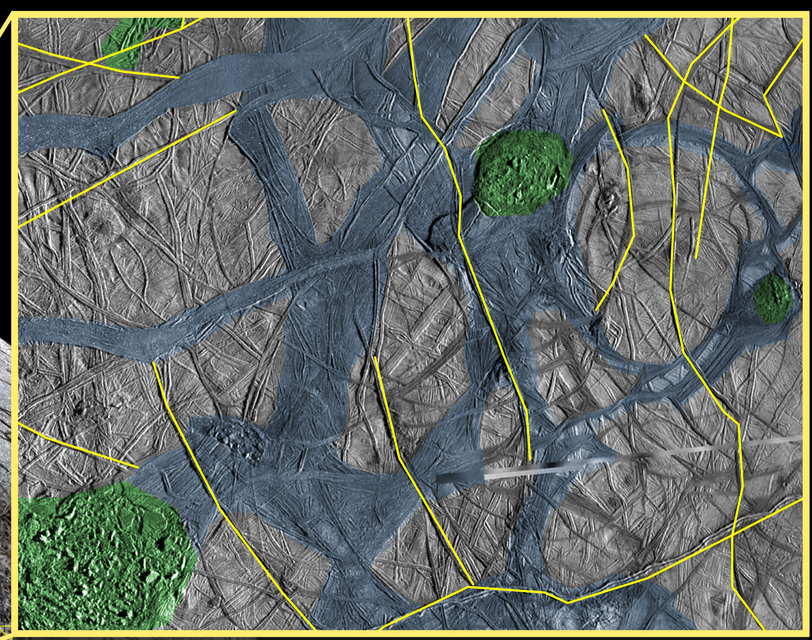
METHODS

We created a preliminary map of prominent **ridges, bands, and chaos** in our study region at a **1:3,000,000 scale** using the USGS global mosaic. Mapping at this scale allowed us to observe **dominant large scale trends** in geologic features but prevented the recognition of smaller, less obvious features. This permitted basic preliminary mapping; **future detailed mapping** at smaller scales will be conducted in more specific regions.

Chaos Bands Ridges

We additionally investigated how these features vary **spatially** and in **orientation.**

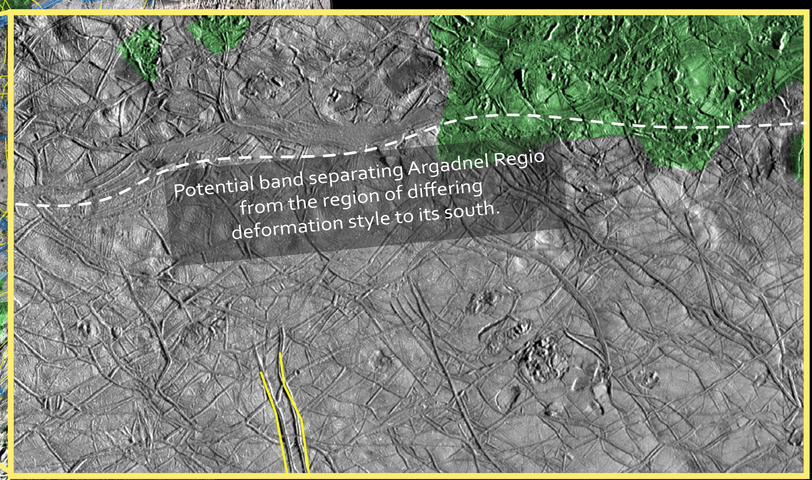




50 Km

ARGADNEL REGIO

The abundance of **dilational bands** identified at this scale in Argadnel Regio illustrates the considerable **extensional deformation that dominates this region**. Bands in Argadnel are preferentially oriented to the **SW-NE** and **NW-SE** implying **two primay periods of deformation**. The plethora of bands indicates that this region is also a **major source of extension** and **emplacement of new surface material**[2]. We additionally found **ridges** in Argadnel Regio to have **no preferential orientation.** This suggests that there is **no preferred stress orientation,** at this scale, responsible for the creation of ridges.



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SOUTH OF ARGADNEL

South of Argadnel Reigo, the pervasiveness of ridges, bands, and chaos **abruptly halts** across an **~E-W oriented linear boundary**. At a smaller scale than what was utilized for our preliminary map, there appears to be **a band associated with this linear boundary**. Opposite of Argadnel, this southern region is dominated by **orthogonally intersecting sets of linear tectonic features** in addition to potential cryovolcanic materials. These characteristics can also be found in **overriding plates in terrestrial subduction zones**. Further mapping will provide insight into **what drives this abrupt change in deformation style.**

CONCLUSIONS

The dominantly extensional tectonic regime of Argadnel Regio ceases at a discrete ~E-W oriented linear boundary. The **style of deformation then abruptly changes** from the **complex arrangement of ridges, bands, and chaos** in Argadnel Regio to **orthogonally intersecting tectonic features** and potential cryovolcanic materials.

Whether or not a plate boundary is responsible for the juxtapostion of these two regions is unknown at this time. Future detailed mapping will provide insight into the mechanism responsible for **Argadnel Regio's highly fractionated surface** and if the **broad-scale deformation patterns** can be reconciled with distributed **plate-like motions**.

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