Europan Surface Ice Texture Genesis, Ocean Exploration, Human Habitation

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Abstract: Europa's multiscale folded surface texture is consistent with new crustal ice co-genesis, following complete melting of earlier crust in the aftermath of super huge impact, the effects on thickening, increasingly salty icy crust, of convergence fronts between wandering, subcrustal ocean thermal convection cells, tidal strains and the double ridge-, band-producing mechanisms of the preceding paper. Subcrustal ocean exploration, human habitation possibilities implicit in the preceding two papers, are explicit in this paper. My remarks are relevant to Gannymede also.

Keywords: Europa, Gannymede, Earth, ocean, crust, space exploration, biosphere

Introduction

The surface texture I refer to is Prockter and Pappalardo's (2000) "complex maze of overlapping surface features that compose Europa's ridged plains".

There is much interest in accessing the possibly life-bearing oceans of Europa and Gannymede through thin encrusting ice. I address Europan crustal surface texture genesis, but my remarks are relevant to Gannymede also.

Opportunities for ocean exploration implicit in the preceding two papers, are explicit in this paper.

EUROPAN TEXTURE GENESIS

I refer to Europa's ubiquitous multiscale, multi-directional folds. The origins of the double ridges, bands, and intermediate forms have been explained in the preceding paper.

Europa's surface texture is consistent with having originated in the aftermath of super huge impact renewal of the surface crust, extension of the ocean.

I propose that the multifold texture is the effect on cooling, thickening, increasingly salty, new icy crust, of convergence fronts between wandering, subcrustal ocean thermal convection cells, tidal strains (Greenberg et al 2000), and the double ridge-, band-producing mechanisms of the preceding paper.

This idea is based on a synthesis of personal observation and experience:

- Milk "scalded" and allowed to "set" in the old-fashioned way produces a similar mutliscale, multi-directional rippled texture on its surface, sometimes producing a large, fundamental fold across the whole width of the "set" cream.

  In the initially thin film of cream, dynamic, fine multi-directional ripples form. These become increasingly coarse, multiscale as the film thickens, and the large volume of milk slowly cools.

  Ripple wavelength is roughly proportional to thickening cream thickness. The similarly textured very salty Europan crust may be similarly formed.
- Very salty ice on wintry Antarctic hypersaline lakes is like icecream: more pliable and viscous and colder than seawater ice, probably tougher too, when extremely cold.

  It is so extremely visco-plastic that it can be safely walked on even when it is pliable, only 2cm thin, and easily pierced. I know this from having accompanied marine biologists studying life beneath such "magic carpets", in the Vestfold Hills, Antarctica, 1974.

  We did not have to "dig" a hole, only "touch" the ice with a spade. It is tough on top, soft underneath, like the "set" cream of traditionally scalded milk.

In the same way, seawater ice is tougher, more visco-plastic than freshwater ice, much safer to walk on. It thus "pops" under tidal and human weight, while freshwater ice "cracks".

Texturally, scalded cream and Europan "salt icecream" are thus putatively similar, similarly formed:

SCALDED MILK

To scald milk, one heats it to just below boiling point so that it does not foam, then allow it to cool. The initial smallscale ripples are tiny, fleeting, dynamic, multi-directional.

The multi-directional rippling process becomes larger-scaled as the cream thickens."Recordings" of the early, small ripples are almost entirely lost, increasingly retained as they coarsen.

The effect can be re-created using small shallow containers of milk heated in a microwave oven. When removed from the oven, the surface films show the initial, fleeting ripples.

These always suddenly disappear after a few minutes, proving that the ripples have nothing to do with air motions, are obviously being produced by subsurface convection cell convergences.

The stationery cream is being "hit" from various directions by wandering convergence fronts.

The container has to be large, the milk allowed to cool in the traditional way to produce the permanent multiscale, multi-directional ripples of the traditional cream surface.

This corroborates "subsurface convection cellular current convergence" genesis. The convection cells in the hot milk beneath the cream film are Benard cells, most easily observed in cooking oil.

They begin small, like the initial, fine textured surface areas, become larger as the oil cools, producing the increasingly coarse textured surface areas.

"SCALDED" OCEAN

I thus propose that Europan multi-directional, multiscale texture has similar "thickening, scalded cream" genesis, consistent with the absence of convergence at Libya Linea, 2.1.

SUPER HUGE IMPACT: A super huge impact, consistent with the dark region of Europa, has evidently fractured the crust and rocky inner planet, heated and extended the ocean, renewed the crust, probably a few 100 Ma ago.

This would probably have been in association with the disturbance of the Oort Cloud, due to the arrival of the brown dwarf star implicated in renewals of Venus', Earth's surfaces, Vol 3.

SURFACE GENESIS: As Europa cooled, its initially thin surface film thickened, began to record the smallscale dynamism of subcrustal ocean convectional cell convergences as multidirectional fine ripples.

Double ridges formed symmetrically along either sides of tide cracks, originally smallscale upon thin, warm, soft crust, as explained in the preceding paper.

As the cooling "salt icecream" thickened, the ocean convection cells beneath it became larger, produced larger-scaled ripples on the thickening ice. Double ridges became larger also, 2.2.

The largest-scale folds, such as in Astypalaea Linea (Prockter and Pappalardo 2000), were thus evidently produced most recently. Tidal forces and radioactivity would have added background heating.

HUGE IMPACTS: That huge impacts have subsequently occurred is corroborated by the phenomena referred to in 2.2: transitions from double ridge to band ridge production and so on.

OCEAN EXPLORATION

The Libya Lineal scenarios of these Vol 2 papers obviously have ocean exploration ramifications, especially the evidence of ~ 1km-thick ice, persistent regional shear stress, white frost maxima at shear strain maxima, 2.1.

LIBYA LINEAL EVIDENCE

In the upper part of JPL (1999) 46 666 9926r image.

Note two multi-fold ”petal” troughs: one coming into the picture from the top left side, the other from just left of centre. Note in the left-side example, how its overlaps are consistent with serial genesis of its multi-folds/”petals”.

Note in left-of-centre example how the “petal” on the RHS of the multi-fold/”petal” trough shows an important shear strain along a new faultline associated with a small, evidently strongly sloping impact.

Note how this strain bends that “petal” into an S-form, opens the trough above the impacted faultline, splits the fold/”petal” below it along the middle, producing a “V” trough strain, marked by white frost to the left.

The RHS “petal” is relatively intact compared to the multi-folds/”petals” to its left, where extensions of Libya Lineal shear strains seem to have produced numerous openings in the ice: crevasses.

OCEAN ENTRY: Water vapour diffusion radiations, indicating a most likely place to find an opening in the ice, confirmed by maximal white frost, can presumably be detected in orbit.

Such indications, probably a crevasse at an obvious shear strain in a non-convergent, shear stressed region, may be the best place to put a swimmer into the subcrustal ocean.

How does the robot swimmer get into the water? I propose Green and Red ways, with Deep variations:

GREEN WAY

In the Green Way, the swimmer is assisted by an ice-drill and surface communicator. In the Deep Green variation, the ice-drill is not radio-actively hot.

A surface communicator may be necessary, connected to the bottom of the ice by a cable installed by the swimmer during descent, because of ionic conductivity of the saltwater ocean and wet bottom ice: a “skin effect”.

RED WAY

In the Red Way, the swimmer robot has smart, impactor companions capable of fracturing Libya Lineal ice and opening up an entry cavity at the fracture from orbit.

Shear stress in the Libya Lineal region may “open up” any such impacted fracture at the next tide, and it may stay open: The swimmer robot stays in orbit until a smart impactor, in the Deep variation a smart bomb, has fractured the ice.

The impact cavity in the ice need not be deep, but the impact fracture must penetrate to the bottom of the ice. The swimmer dives into the flooded cavity directly from orbit, without touching the ice.

Direct communication at the end of the experiment would be from the exposed surface of the water in the cavity, without any need of an ice surface communicator.

The Red Way thus simplifies communications with the Earth as well as ocean entry. In a Deep, Deep variation of the Red Way, the bomb is a “mini-nuke”, a micro-critical thermonuclear explosive.

HUMAN HABITATION

The apparent durability, structural soundness, ideal size and architectural beauty of Europa’s ubiquitous double ridge spiral “petals” are consistent with human habitation possibilities:

Human space explorers need to be provided with adequate shielding against micro-meteorites and radiation, especially in the Jupiter region. Massive structures are the best shielding against such hazards.

Many long segments of the largest double ridges show minor departure from original form, minimal collapse along crack-adjacent surfaces.

The spaces below the inner surfaces at the gap, between putative stem and inner spiral in these examples, may be intact often spacious, reminiscient of cathedrals.

Combine this with their prime positions adjacent to tidal cracks in shear-strained regions promising access to extra-terrestrial ocean, and the “salt icecream petals” begin to look like an important resource.

Their most obvious use is as a radiation shield to a linear city. Given their apparent stability, they may be so utilisable almost immediately.

Manned space exploration is indicated in Vol 3, paper 16, and Vol 4 of this CD set.

A longer term possibility would be to convert the best of them into "biospheres", by finding and sealing their cracks and filling them with air and light.

This makes good sense architecturally because, not only would these spaces be extraordinarily beautiful, frozen condensation from human occupation would make them stronger, better sealed.

They may have been so viewed already: See the impacted, rectangular "groundscaper" adjacent to the RHS of the double ridge in the bottom RHS corner of JPL (1999) 17ESSTRSLB01 image: 46 666 0200r!

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