Igloo Concept

James Wise
Programmer/Analyst/App Developer
jameswise@gmail.com | www.jameswise.net

Sep 21, 2013

1. A feature, not a bug

One of the biggest challenges is Europa's hostile environment – extreme cold and radiation being frequently cited as some of the main problems. However, Europa itself may also provide many of the solutions. There are vast amounts of ice, which also means water, which means hydrogen and oxygen, which means energy and air (potentially) and even shelter. In principle, all that's required to harness these resources is an initial introduction of energy. I'm no scientist (nor artist – see Fig. 1!), so I apologise in advance if any of this is wildly naïve or the maths or practicalities mean that any or all of these ideas impractical, but I'm going to outline a possible approach below, which I hope may be of use, at least conceptually, at some stage in the project.

2. Phase I – Explorer

Send an orbiter (similar to the Mars Reconnaissance Orbiter) to map the surface in detail, assess the viability of surface based missions and identify potential landing sites, check for risks such as ice calving etc. Could provide support to later missions, ie relaying communications, checking radiation from Jupiter, constant update on surface conditions etc.

3. Phase II – Pioneer

An unmanned robotic mission is sent to the surface of Europa, its goal is to establish some early tools and infrastructure to pave the way for further missions. Powered by a nuclear battery, its main aim, though, would be to begin the production of hydrogen from Europa's ice, to provide energy from later missions. This is not a new idea and am not sure how long it would take to provide sufficient quantities, but in melting ice it may make a start on the eventual drill site, perhaps preparing a more suitable/flatter landing site for later missions in the process. As everyone knows, the ice would have to be melted, then hydrogen and oxygen extracted using electrolysis-distillation and stored. Main challenges would be – having enough

salt, anode and cathode materials and somewhere to store the gasses – would they be liquids or solids at such low temperatures? Could ‘inflatable’ sacks be used?

4. Phase III – Initial descent/’Igloo’

A second robotic mission lands at the Pioneer location and makes use of the resources and tools established by the previous mission. Its goal is to tunnel down into the ice by a suitable distance, ie completely protected from any radiation or micro meteorites and to a ‘stable’ location, ie as identified as being low risk from calving or other internal stresses. At this location it would calve out a ‘cave’ or ‘igloo’ in the ice, using the hydrogen and/or oxygen energy produced by the earlier mission. Perhaps it could do this simply by using lasers. The water would have to go somewhere, while obviously it could be useful for later missions, there may have to be a separate ‘chamber’ in which to store it and pressure or energy to keep it liquid. Depending on feasibility, this phase could also prepare the igloo for later missions/human habitation, by establishing things like lighting, heating, inflatable habitats, perhaps even planting crops and growing food hydroponically. Perhaps the growing of the food could assist with air production from some of the extracted oxygen, although this mission would have to carry the other constituents of air to get that started.

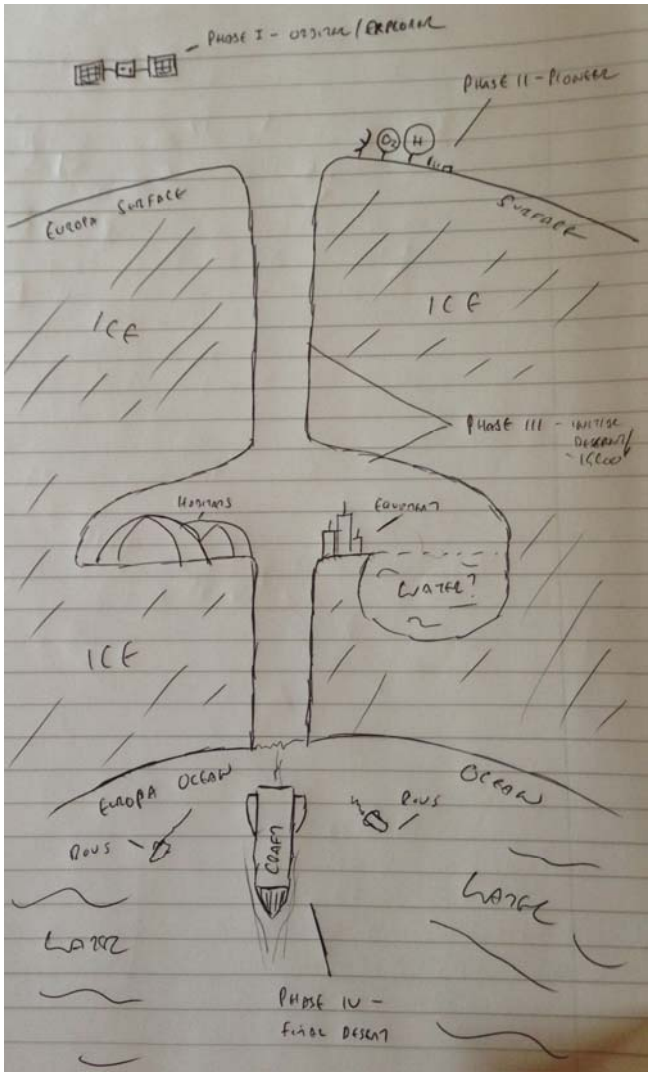

Fig. 1: Igloo Concept diagram

5. Phase IV – Final descent

Finally the manned mission can arrive on Europa. One of the benefits of the earlier phases is that we would be much more experienced with landing vehicles on Europa and have much more data about the surface and conditions there. The human spacecraft will also be the craft used to tunnel the remaining distance to the surface of Europa's Ocean. It would have to land, descent through the tunnel established by the first phase, 'dock' in the igloo and then continue the descent through the ice, finally getting to the ocean and allowing exploration. With the igloo established as a permanent, self-sustaining 'basecamp', multiple missions and perhaps long life spans could be supported.

6. Conclusion

The phases described in this approach could be further subdivided or combined, depending on logistics, practicality and cost. I'm aware it's hugely ambitious, costly and, likely, beyond our current technology somewhat. However, I believe utilizing the resources and opportunities the unique properties of Europa affords, will be the most practical way to explore it.

What, though, is the main aim of this mission? Is it to have landed a human on Europa, or is it to answer the question of whether life exists in the ocean under its crust? (For that matter, have we even definitively answered the question whether the ocean *does* exist? I thought it was just theory at present.) At any rate I think the second aim is the most important. A robotic mission could be much smaller, executable in less phases, perhaps even only one and the problem of food and habitation would not have to be addressed. Perhaps a robotic probe could land, begin melting through the ice with a conventional heat source and then just use the oxygen and hydrogen generated using electrolysis on the way down to continue it's journey. Either way the main aim, I think, is to get a probe and cameras into that water, test for life and send back the results.