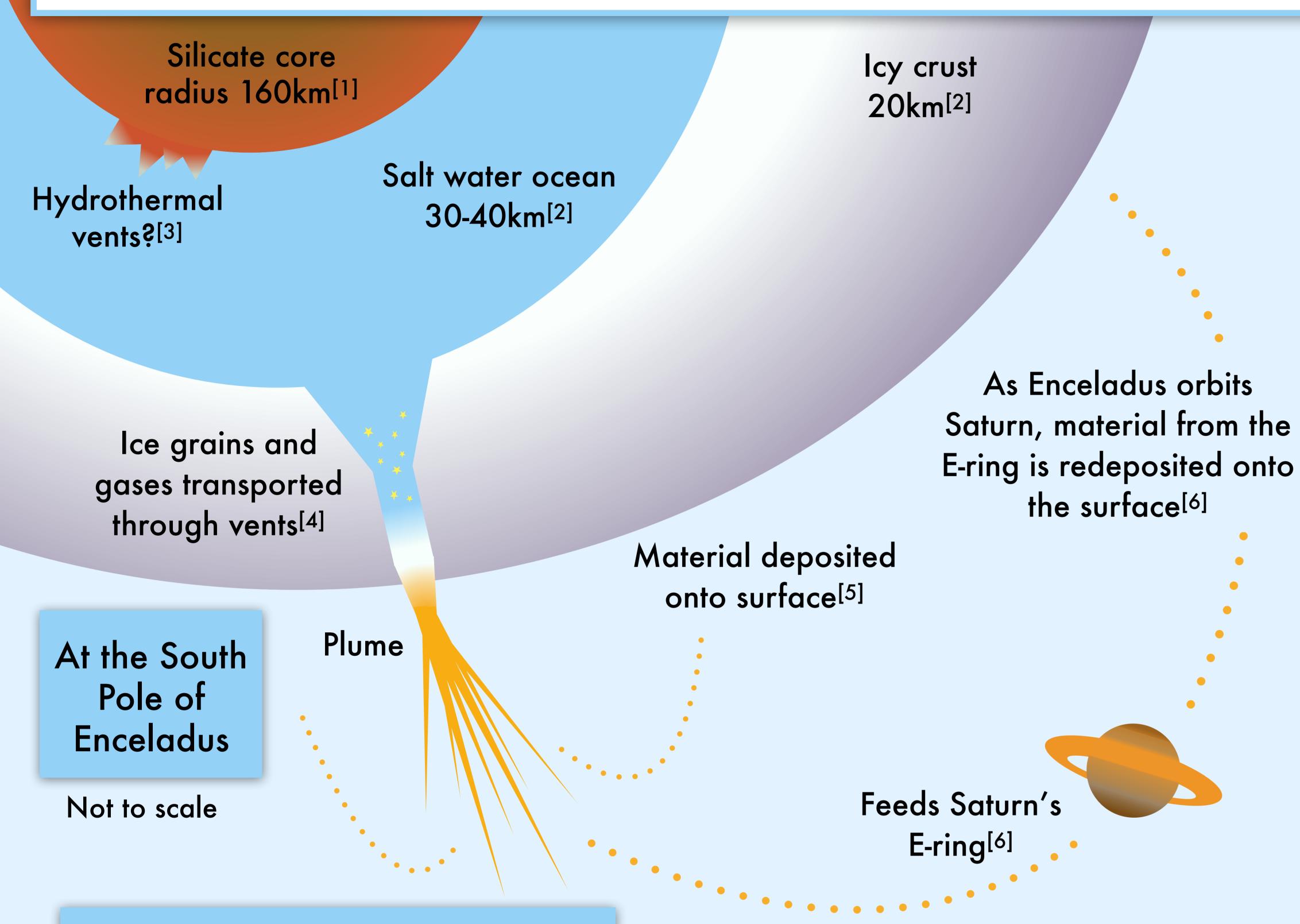


# Looking for life: Unlocking the secrets of Enceladus' surface

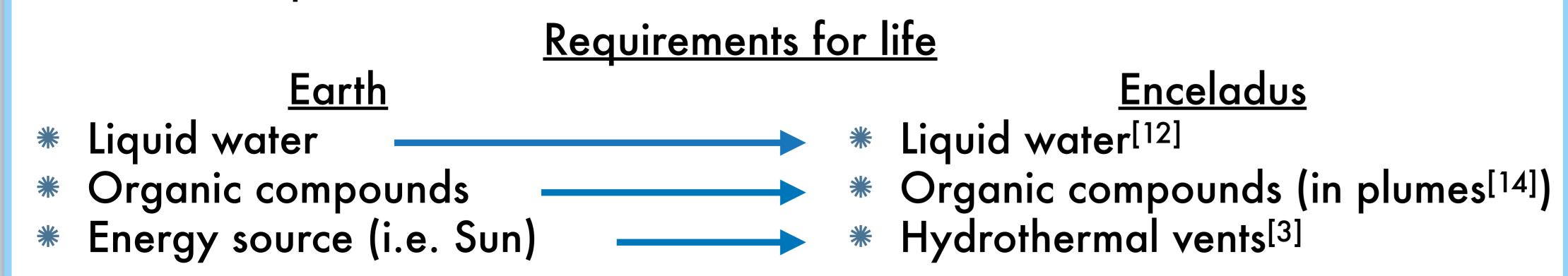
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## Why go to Enceladus?

Enceladus is an icy moon of Saturn. It has a deep subsurface liquid saltwater ocean and plumes which eject material thousands of kilometres into space via fractures in the icy crust<sup>[12]</sup>. There is evidence for hydrothermal activity in the rocky core<sup>[3]</sup> and water-rock interactions which could provide the ideal chemical conditions required for life<sup>[13]</sup>.



#### Aims of PhD

Develop protocols and instrumentation which could extract volatiles and analyse the icy surface of Enceladus:

- \* Establish representative ice compositions and determine if this could be indicative of habitability beneath the icy crust
- \* Develop apparatus and methods to grow ices in the lab
- \* Evaluate how composition is affected by space weathering processes
- \* Design a mass spectrometry-based instrument to analyse volatile components of ice
- \* Benchmark the performance of the instrument against commercial laboratory equipment

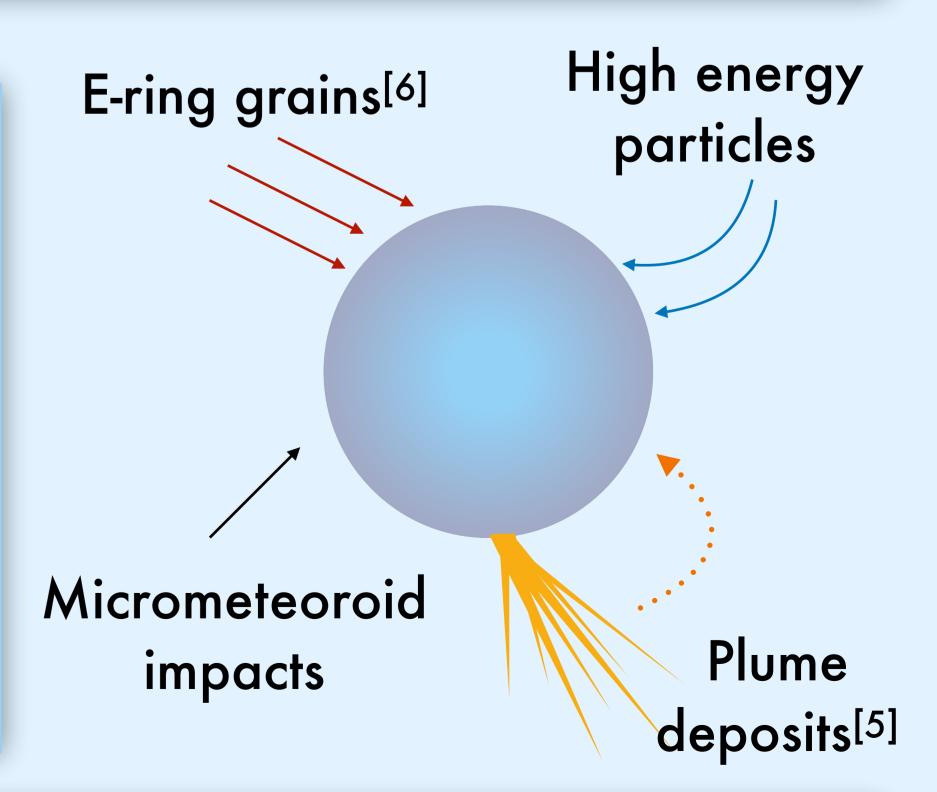
### What do we expect to find?

Data for the surface composition comes from spectroscopy in the mid IR through to the far UV range. The only components which have been firmly identified are H<sub>2</sub>O and CO<sub>2</sub>. Plumes may deposit material and space weathering is expected to modify this<sup>[5]</sup>.

- \* Water<sup>[7]</sup>
- \* Carbon Dioxide<sup>[7]</sup>
- \* Organics?[7]
- \* Ammonia?[7]
- \* Tholins?[8]
- **\*** Iron<sup>§[9]</sup>
- \* Hydrogen peroxide?[10]
- \* Methanol?[11]

## Space weathering

By theoretical modelling and laboratory simulations, I will determine how space weathering affects surface composition. Understanding how these processes affect the satellite is vital to developing instrumentation best suited to analysing surface components.



[1] Nimmo, F et al. (2006) Nature 442: 614-616 [2] Thomas, P et al. (2016) Icarus 264 [3] H, Hsu et al. (2015) Nature 519: 207-210 [4] Postberg, F et al. (2009) Nature 459 1098-1101 [5] Jaumman, R et al. (2008) Icarus 193 407-419 [6] Kempf, S et al. (2010) Nature 206 446-457 [7] Brown, R et al. (2006) Science 311 1425-1428 [8] Hendrix, A et al. (2010) Icarus 206 608-617 [9] Kempf, S et al. (2005) Science 307 1274-1276 [10] Newman, S et al. (2007) The Astrophysical Journal 670 143-146 [11] Hodyss, R (2009) Geophysical Research Letters 36 17 [12] Porco, C et al. (2006) Science 311 1393-1401 [13] Waite, J et al. (2017) Science 356 155-159 [14] Waite, J et al. (2006) Science 311 1419-1422