After a happy time chatting online with friends about pumice, volcanoes and tsunami Roxanne and Gemma continued their explorations of Balon Beach and environs (Figure 15 on page 38). After a good walk they rested on the beach where Blackwater Creek reaches the coast. Here a back-dune lagoon forms when the stream is unable to flow out to the sea (Figure 24).

Figure 24: The exit point of Blackwater Creek estuary into the ocean and the lagoon build up.
Image courtesy of Roxanne Stone.

41. Sandra was quick to ask about the lagoon water. She noted that it was a dark brown colour but still with a distinct clarity, as shown by the bottom sand that is clearly visible in the shallows.

Q: What did Roxanne say to explain the appearance of the lagoon water? (1 mark)

Many factors determine a lakes clarity and colour but at this location the most likely explanation for the water's appearance is …

a. Plant-matter tannins leaching into the waterway from the surrounding forest.
b. Low water turbulence due to low winds and lack of recent heavy rain.
c. Insoluble iron oxides leaching into the waterway from the surrounding quartz-sand dunes.
d. A recent breach of the beach dune to allow the outflow to restart, taking with it all the suspended clay sediments built up in the lake over time.
e. Both a) and b)
f. Both c) and d)

42. The conversation then expanded to discuss more about the lagoon and estuary.

Gemma's friend, Rose Kortz, said …

It's a beautiful spot but last time I was there the lagoon-estuary was not flowing out to sea. What's changed?

Q: What did Gemma say in response? (1 mark)

The surface outflow from the lagoon into the ocean happens when …

a. …rainfall in the Blackwater Creek catchment has increased. Sometimes input into the catchment is insufficient to exceed the seepage that occurs through the porous beach sand. With increased runoff, the lagoon has overtopped the beach dunes to flow across the surface and erode a channel.
b. … the rate of sand being built across the entrance by wave-driven longshore drift does not exceed the rate at which a small surface flow can push the sand out of the way.
c. …both a) and b)
d. …evapotranspiration in the catchment forest increases. A successful reforestation program has increased runoff, causing the lagoon water to overtop the beach dunes and erode an outflow channel.
e. … all of a), b) and d) occur.
f. …all of a), b) and d) occur if and only if humans excavate a channel first.

The second object they picked up, just as they reached the outflow point, was a nicely rounded rock (Figure 25). The photographs from this location kicked off a social media storm with lots of comments about how beautiful the place looks and a big discussion about the nicely rounded rock.

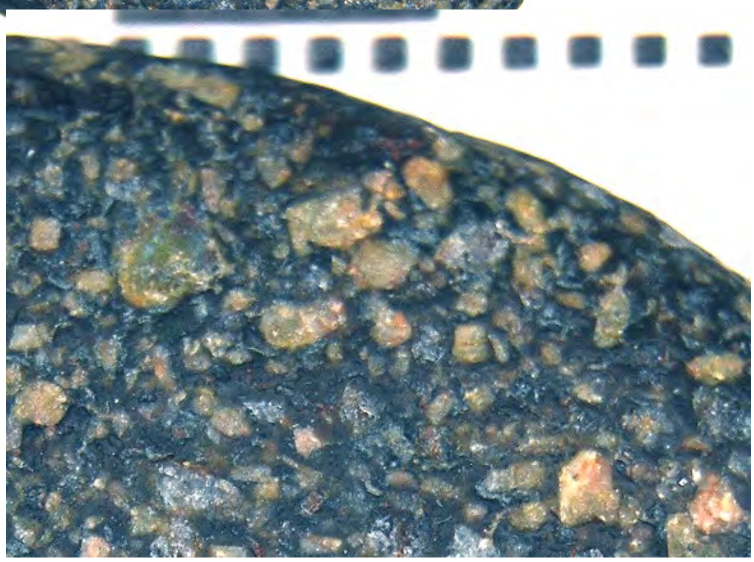

Figure 25: The second object collected on Balon beach.
Image courtesy of Roxane Stone.

43. They all had an opinion about the rounded rock but everyone agreed on one of three options for its appearance:

- Philip Light thought the rock looked metamorphic because of its crystalline appearance.
- Gabbi Roe agreed with it having a crystalline appearance but insisted it was an igneous rock.
- Sandra Shore thought it was a sedimentary rock because of its granular appearance.

Q: What did Roxanne say in response to all these comments? (1 mark)

The nicely rounded pebble …

a. …is so thoroughly rounded by movement in a stream that all evidence of its origins has been removed.
b. … is a sandstone with a very fine grained (clay) matrix. It cannot be a crystalline igneous or metamorphic rock because the light-coloured grains are all very rounded quartz grains 1-2mm in diameter.
c. … is a crystalline metamorphic rock because the light-coloured angular grains have their longer axis orientated perpendicular to the directional forces applied at the time of the metamorphism.
d. … is a volcanic igneous rock because the light-coloured angular grains are randomly orientated quartz and feldspar crystals (phenocrysts) within a dark-coloured glassy (non-crystalline) groundmass.
e. …is a crystalline (non-sedimentary) rock that could be either igneous or metamorphic but that degree of identification would require laboratory analysis.
f. … is a plutonic igneous rock because the rock is composed entirely of randomly orientated interlocking crystals greater than 2mm in diameter.

After Rose's first message, a second message from her arrived. It was time-stamped as being sent just a few seconds later than the first message and read:

I am on Titan at the moment. It feels weird to be so far away (given our current orbital positions, we're about 1.41 x 10^9 km apart) and even weirder that I'm looking at a very similar lagoon, albeit one filled with liquid methane! BTW, did I tell you Gabi and I are on Titan ground truthing parts of the Dragonfly mission conducted back in 2034?

Gemma replied: *Yes, you did tell us about your trip to Titan – no need to boast. We're all looking forward to your report!*

44. Rose sent her second message via the deep-space radio network shortly after the first but it was sometime before Gemma received it because even with all our amazing new technologies nothing travels faster than the speed of light.

Q: What minimum time must have elapsed between Rose sending the second message and receiving Gemma's immediate reply? (1 mark)

a. About 1 hour and 18 minutes.
b. About 2 hours and 36 minutes.
c. About 3 hours and 54 minutes.
d. About 5 hours and 12 minutes.
e. About 39 minutes.
f. Two seconds.

45. Rose also sent several maps to her friends, indicating where she was (Figure 26 on the next page and Figure 27). She said …

We are documenting the lake and sea dominated terrains of Titan. They form a major landform as you can see on the maps and we have surveyed them in polar latitudes and elsewhere. Some are currently empty but they all form within closed topographic lows.

Gemma wanted to know where Rose had spent most of her survey time,

Rose replied… *it turns out that time spent confirming all lake margins and significant landforms such as estuaries and deltas were mapped accurately is roughly proportional to the time spent mapping the lake area. That means I spent most of my time…*

Q: In which area of Titan did Rose say she'd spent most of her survey time? (1 mark)

a. ... in the southern polar region.
b. ... in the northern polar region.
c. … in the equatorial region.
d. … equally between each polar region with a smaller amount spent on more equatorial areas.
e. … equally among all latitudes.
f. … equally in each hemisphere's mid-latitudes (defined for convenience as between 25^o and 55^o North and South for Titan).

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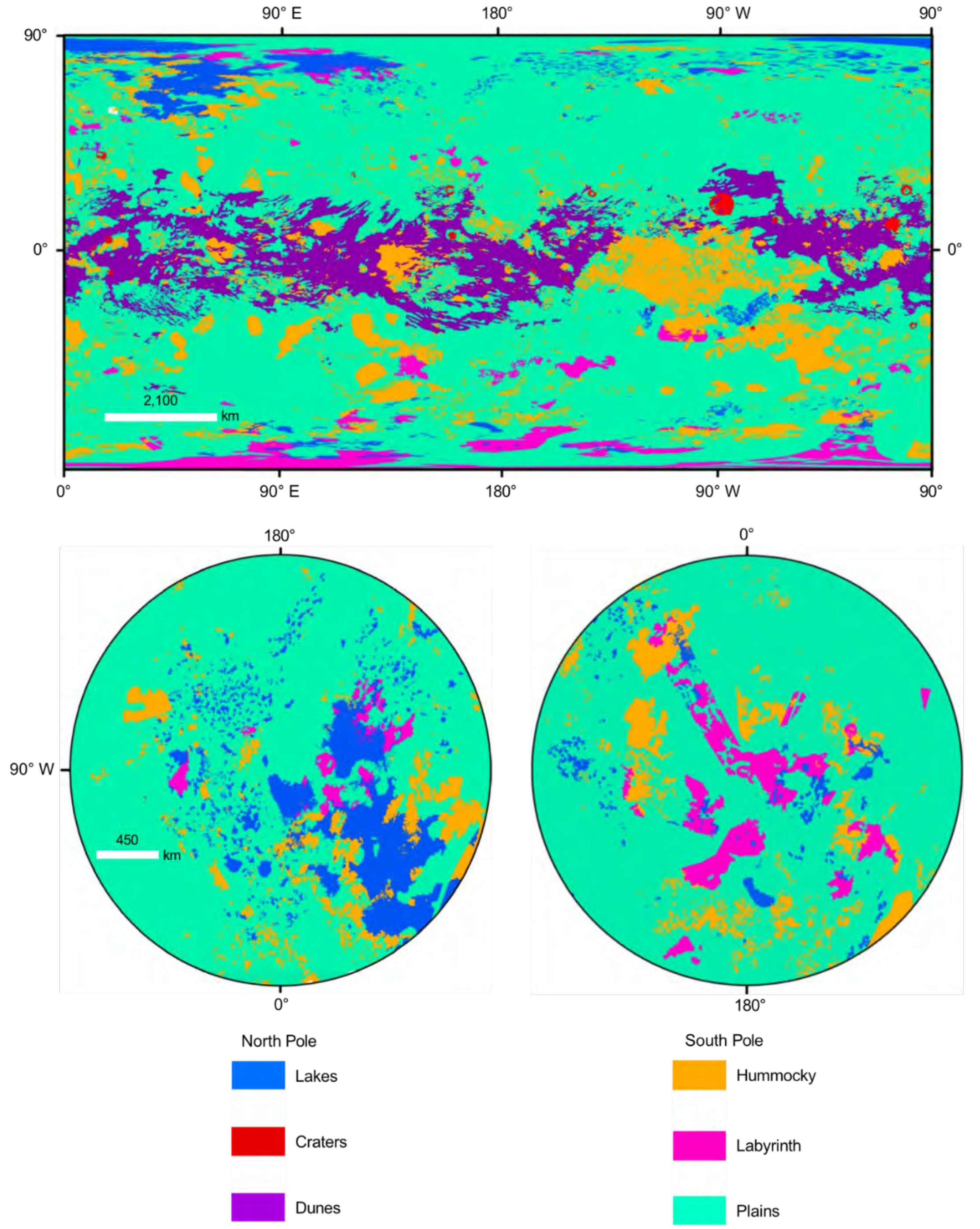


Figure 26*: Major terrains of Titan. Top view is a Mercator projection. Titan's North to the top. Bottom views are polar sterographic projections showing landscapes > 55°N centred on the North Pole and 55°S centred on the South Pole.*

- Hummocky terrain indicates mountain chains and elevated areas.
- Labyrinth terrain indicates deeply incised plateaus with lots of dendritic and rectangular river channels.
- Plains areas lack significant topographic relief.
- Dunes are 100's km long and narrow with grain transport mostly east to west.

Modified from Lopes et al, 2019.

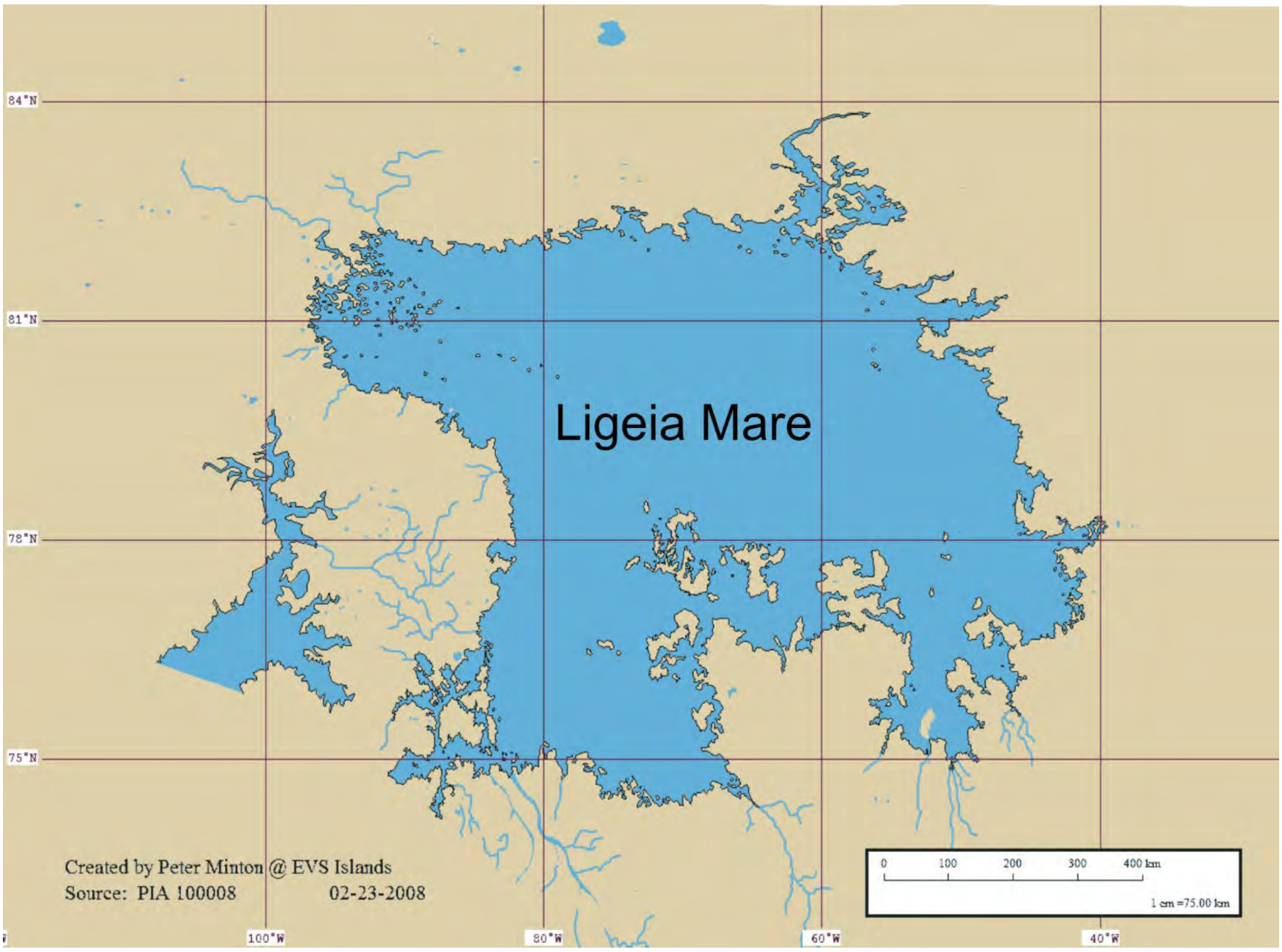
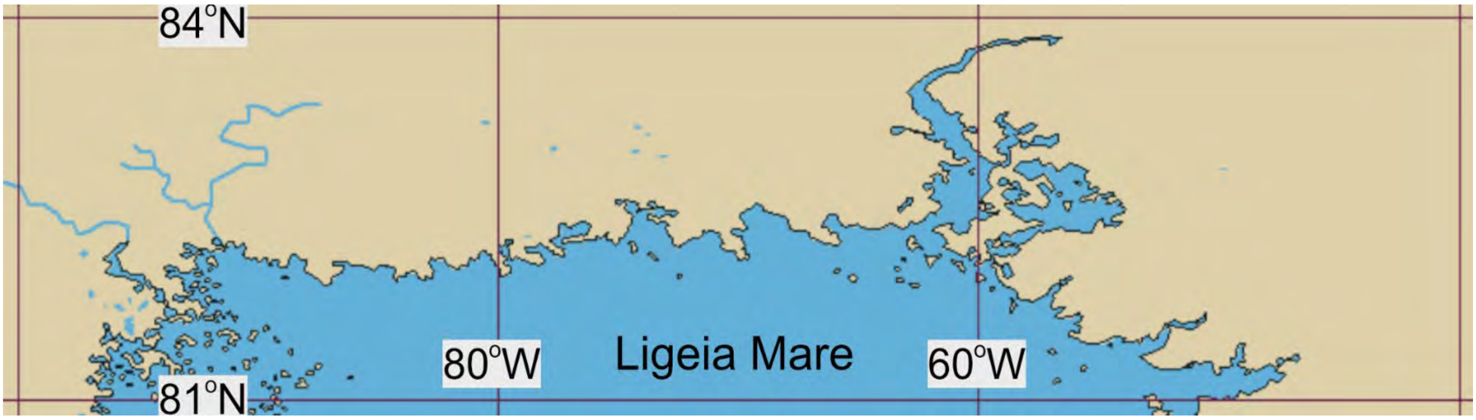


Figure 27a (above)*: Map of Titan's second largest lake, Ligeia Mare.*

Modified from image at https://tinyurl.com/yeyrtndu

Figure 27b (below). Enlargement of the map area between 100°W & 40°W and 84°N & 81°N.



46. Referring to the map (Figure 27), Rose mentioned she was investigating a setting on the northern shores of Ligeia Mare, similar to the one Gemma and Roxanne were enjoying at Blackwater lagoon.
She added …

…It is similar but a major difference is that the lake is almost pure methane and the surrounding bedrock is mostly frozen water with the rock-hard-ice a cool -179°C. I'll send you my location data so you can see where I am.

Q: Which location (easting and northing grid reference) did Rose send? (1 mark)

a. 77.70°W - 75.13°N
b. 77.70 °W - 82.25 °N
c. 91.33 °W - 80.00 °N
d. 91.33 °W - 82.25 °N
e. 60.20 °W - 82.37 °N
f. 60.20 °W - 75.13 °N

47. Rose also sent some images of the deposition environments she was finding (Figure 28 in the next page). When Sandra saw the images, she commented…

…The amount of rounding is telling. I am guessing the clasts have been transported just as far as hard rocks like quartzite here on Earth to get that rounded. Rose replied: … *lithology exerts a very important control on pebble abrasion rates. She copied in a link to Figure 29 to demonstrate her point.*

Q: What was Sandra able to conclude from this chart? (1 mark)

Under similar transport regimes …

a. … quartzite on Earth is a good analogue for 100 K water ice on Titan.
b. … 100 K water ice on Titan abrades faster than most silicate rocks in a similar environment on Earth.
c. … 100 K water ice on Titan abrades slower than all carbonate rocks in a similar environment on Earth.
d. … carbonate rocks abrade slower than quartzite and some igneous rocks.
e. … mica-rich schists and poorly cemented sandstones are not good analogues for 100 K water ice on Titan.
f. All of the above.

Figure 28: *Rounded pebbles and boulders on Titan.*
Image courtesy of NASA.

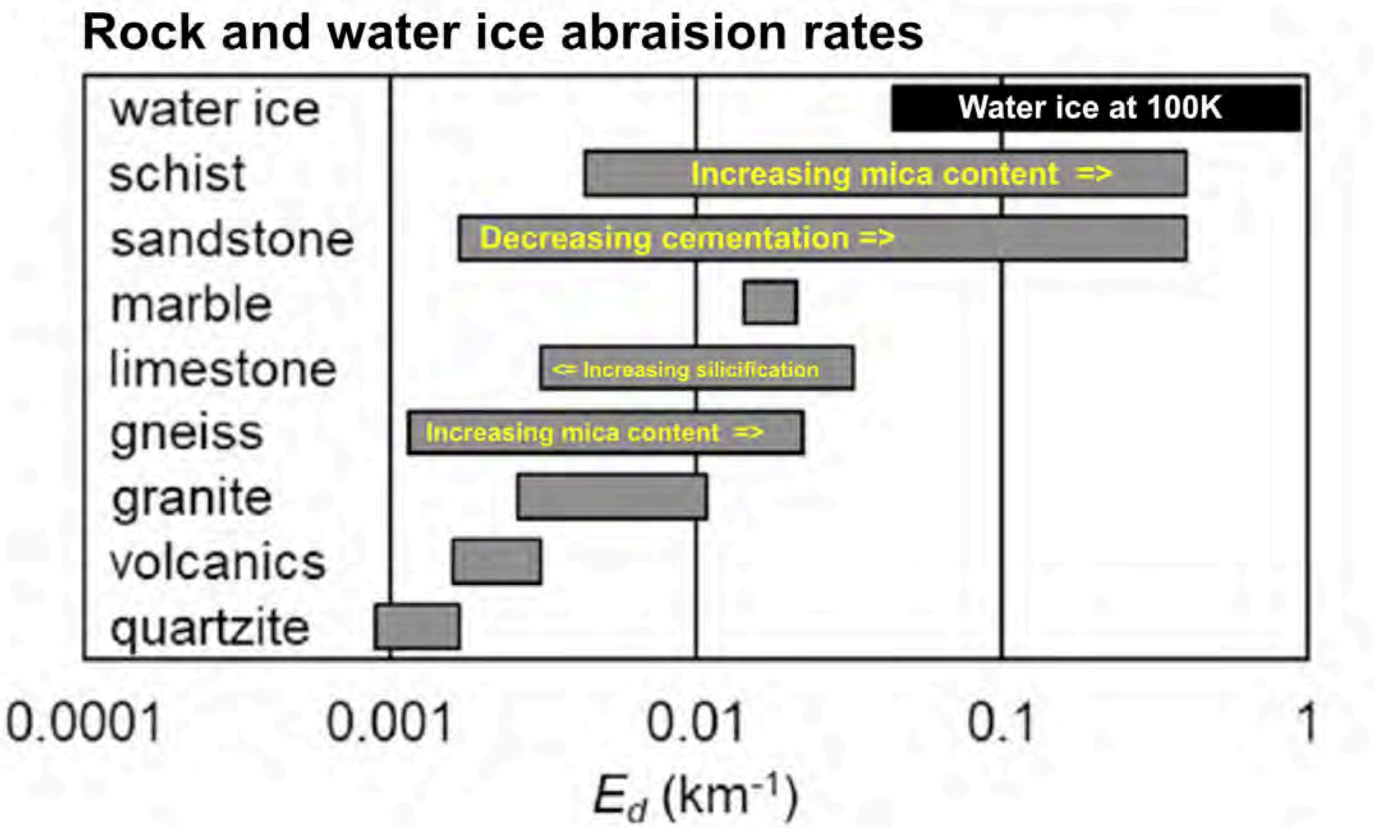


Figure 29: *A chart summarising a range of abrasion rates of various terrestrial lithologies (dark gray) compared to water ice at ~100 K in a Titan sediment transport simulation (black).* E_d *is the abrasion rate given as % mass loss / km..*
Image modified from Maue et al, 2022.

Gabi, also on Titan, sent Sandra's two images to assist the discussion (Figures 30 & 31).

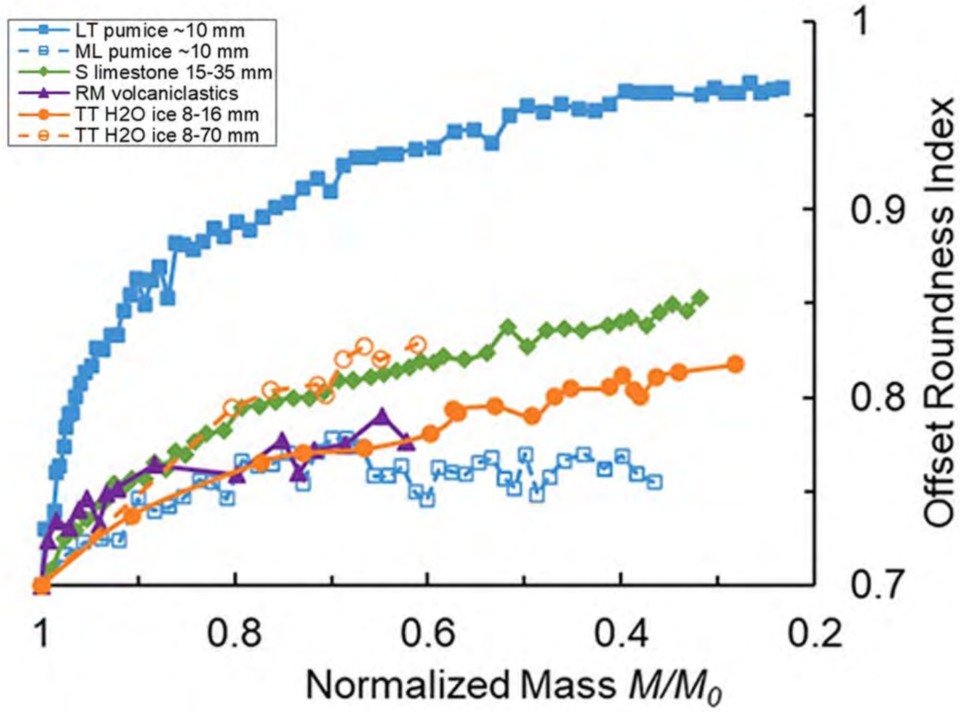


Figure 30: *A graph of the loss of mass as boulders round for a variety of lithologies. LT & ML are both pumice but LT was erupted into an aqueous environment and ML was deposited from air-fall. Both TT curves are for Titan water-ice at ~100K. but one for a narrow range of starting sizes and the other with a wider range of starting sizes. Note: the mean roundness indices for all grain types have been offset to all start at 0.7 to better compare rates of change. Image modified from Maue et al, 2022.*

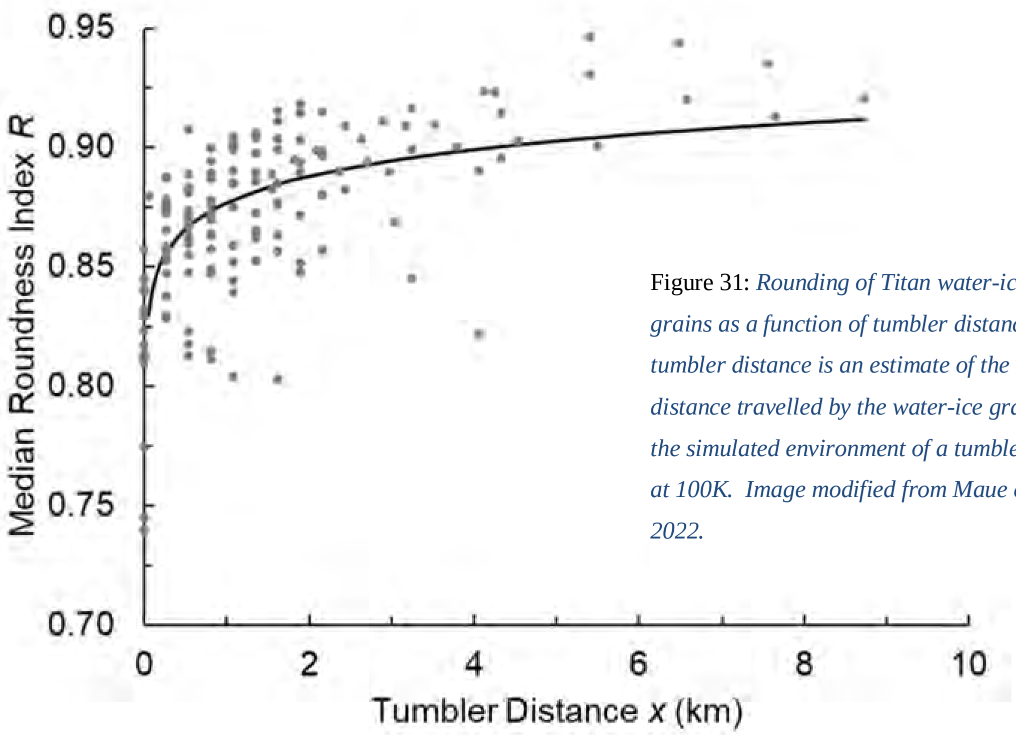


Figure 31: *Rounding of Titan water-ice grains as a function of tumbler distance. The tumbler distance is an estimate of the distance travelled by the water-ice grains in the simulated environment of a tumbler kept at 100K. Image modified from Maue et al, 2022.*

48. Gabi said that her observations on Titan concurred with the experimental tumbler work.

Q: What did Gabi correctly say about Titan's sediments? (1 mark)

a. Abrasion of the water-ice boulders and pebbles will not produce water-ice sand, silt or clay sized grains because the smaller grains will melt from the abrasion.
b. An 8-70 mm water-ice grain size mixture at 100 K behaves more like submarine pumice than subaerial pumice.
c. An 8-16 mm water-ice grain size mixture at 100 K behaves more like submarine pumice than subaerial pumice.
d. An 8-16 mm water-ice grain size mixture at 100 K behaves more like a limestone than volcaniclastic material.
e. An 8-70 mm water-ice grain size mixture at 100 K behaves more like a limestone than a volcaniclastic material.
f. Abrasion of the water-ice boulders and pebbles on Titan is inconsistent with the abrasion of silicate or carbonate boulders and pebbles on Earth.

49. In addition to the two graphs, Gabi also sent through a quick analysis of the roundness indices for the boulders and pebbles in Rose's photograph (Figure 32 on the next page).

Q: What was Sandra able to conclude from this data? (1 mark)

The grains in this photograph have (on average) travelled …

a. … an unknown distance but are not made of ice.
b. … between 3.0 km and 4.0 km.
c. … between 2.0 and 3.0 km.
d. … between 1.0 km and 2.00 km.
e. …between 500 m and 1000 m.
f. … less than 500 m.

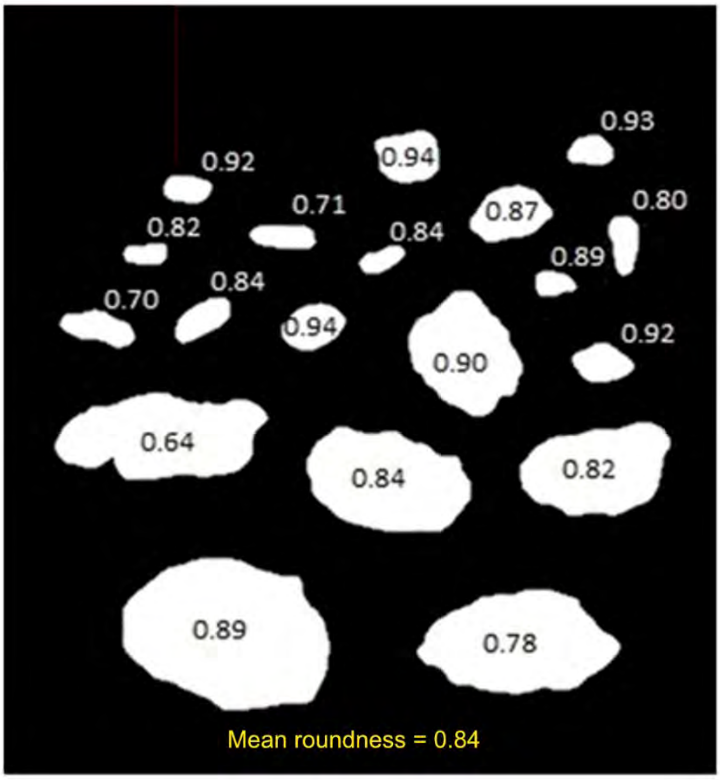


Figure 32: *Estimated roundness of grains seen in Rose's photograph of sediments on Titan (Figure 28).*
Modified from Maue et al, 2022.

Mean roundness of grains in Figure 32 is 0.84

NB: Roundness is the measure of the sharpness of a particle's edges and corners. The higher the value the more rounded the grain. It is a useful indicator of a sediment grain's transport history – see Figure 31.

50. Sandra was impressed with the roundness analysis.

Q: What else was Sandra able to conclude from this data? (1 mark)

Some of the grains in the photograph …

a. … are not made of water ice.
b. … might have travelled for more than 6 km.
c. … are adjacent to their source.
d. … both a) & b).
e. …both a) & c).
f. … both b) & c).

51. Roxanne sent Rose and the group a message about the map of Titan shared earlier (Figure 26 on page 59). She made a statement that Rose and all the friends agreed was correct.

Q: What correct statement did Roxanne make? (1 mark)

a. The equatorial region is dominated by a monodirectional wind.
b. Methane rain is more common in mid-latitudes (30^o – 55^o) than elsewhere.
c. The polar regions have very similar geographies.
d. The northern mid-latitudes (N30^o – 55^o) are more mountainous than the southern mid-latitudes (S30^o – 55^o).
e. Large impact craters are a common feature on the surface of Titan.
f. Titan's atmosphere is too cold to form strong winds.

52. Sandra also sent Rose and the group a message about the map of Titan's Ligeia Mare shared earlier (Figure 27 on page 60), stating that Titan's lakes looked very familiar and predicted detailed mapping of the area would reveal many features also found on Earth.

Q: Which feature did the friends disagree with her about, stating there is no evidence for it on the maps provided and it cannot be reasonably inferred as likely from the geography? (1 mark)

a. Deltas where major drainage channels enter the lake.
b. River meanders.
c. Coastal beaches.
d. Fringing reefs.
e. Stratified sedimentary deposits on the lake floor.
f. Coastal erosion.

Gabi also posted on social media that she was busy doing a bathymetric survey on a large lake on Titan, known as Ontario Lacus. She also explained that her 13 near-shore bathymetric transects revealed the lake floor's slope profile out to a depth of 10 metres (Figure 33 and Table 3).

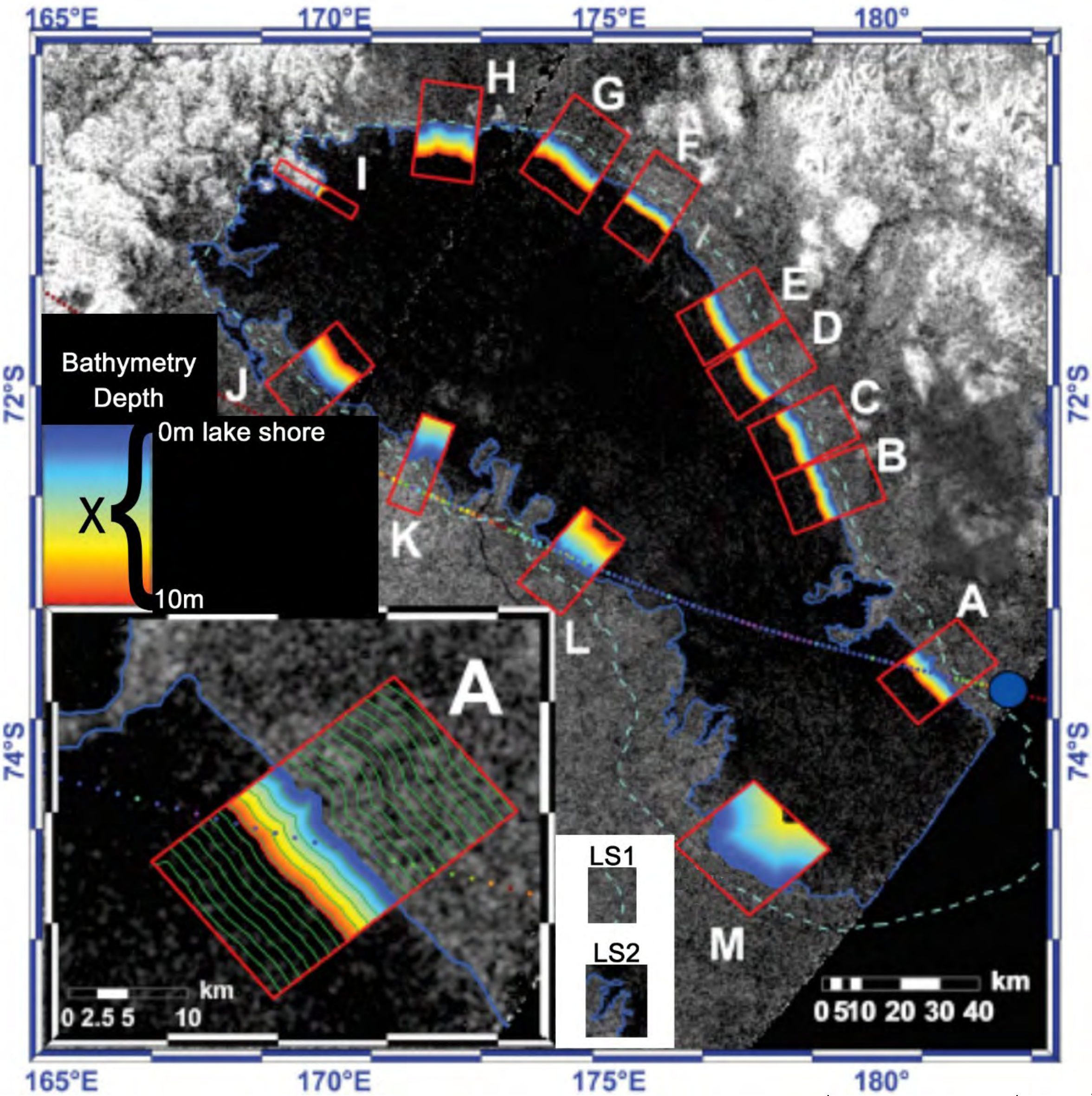


Figure 33: *Map of Ontario Lacus. Red boxed areas, A to M, show where bathymetry has been accurately mapped from the shore line (nominally 0m) to a depth of 10m.*
Inset box LS1 indicates the line used to mark the early 21st Century estimate of the shoreline location.
Inset box LS2 indicates the line used to mark the shoreline as currently mapped.
Inset bathymetry colour bar indicates colour scheme for changes from the shoreline at 0m to 10m depth. X indicates the horizontal distance from the shoreline to a point above the 10m bottom contour. X for each of A to M is given below.
Inset enlargement of location A shows lines either side of the 0m shoreline that are a constant distance from the shoreline.
Image modified from Hayes et al, 2010.

A - X = 5,000m	H – X = 7,142m
B – X = 3,968m	I – X = 2,061m
C – X = 4,366m	J – X = 8,064m
D – X = 4,273m	K – X = 13,513m
E – X = 4,484m	L – X = 10,000m
F – X = 3,731	M – X = 25,641m
G – X = 5,405m	

Table 3: *Values of X for locations A to M, where X is the horizontal distance from the lake shire to the 10m depth contour. .*
Adapted from Hayes et al, 2010.

53. All Gabi's friends were amazed by the Earth-like appearance and topography of the lake (Figure 33).

Q: What did Gabi add to her comments about the lake's shallow topography? (1 mark)

a. The lake's bathymetry indicates it is formed by vertical faults creating submerged cliffs beyond 10 metres depth.
b. The lake is never deeper than 10 metres deep.
c. The lake's bathymetric slopes are totally inconsistent.
d. The lake's bathymetric slopes are consistent for its entire perimeter.
e. The western shore (J-M) of the lake has shallower bathymetric slopes than the eastern shore (A-G).
f. The western shore (J-M) of the lake has steeper bathymetric slopes than the eastern shore (A-G).

54. Andy, still on Io, was impressed with the map data and chimed in with another good observation that everyone agreed was true. He said …

Even though the shoreline mapped in the early 21st century is low resolution compared with the current shoreline map, we know from other evidence that the shoreline has receded from where it was in 2004 to where it is now.

Q: What did Gabi say about this observation? (1 mark)

Given the lake is filled with liquid methane, this indicates a gradual …

a. … increase in the methane precipitation rate assuming the evaporation rate is unchanged.
b. … decline in the methane evaporation rate assuming the infiltration rate is unchanged.
c. … increase in the methane evaporation rate assuming the infiltration rate is unchanged.
d. …increase in cloud cover over the southern hemisphere.
e. …increase in cloud cover over the northern hemisphere.
f. … decline in the methane precipitation rate assuming the evaporation rate is unchanged.

55. A great many conversations about the lake followed.

Q: What else did Gabi say about the lake's geography? (1 mark)

The differences in distances between the old shoreline and the current one (at locations A to M) are best explained by …

a. … the slope of the landscape just above the current shoreline being different at each location.
b. … the slope of the landscape just below the current shoreline being different at each location.
c. … the geology of the bedrock being different at each location.
d. … the permeability of the bedrock being different at each location.
e. … the porosity of the bedrock being different at each location.
f. … the slope of the landscape being a function of the rainfall at each location.

It had been a long day on Earth for Roxanne and Gemma as they explored their favourite coastline, exchanging messages with their friends on Earth and spread out across the Solar System. A surprise visitor to the beach, their very good friend and fossil fish expert –- Jeff Gnathostomes – emerged from the surf at Balon Beach to say hello and spend the afternoon with them beachcombing as they walked to a well-known camp site between Yara Point and Cape Greyjoy (Figure 26 on page 59).

56. Jeff had enjoyed his swim from Stark Reef near Cape Greyjoy to Balon Beach because swimming is always good and Stark Reef is a beautiful, complex ecosystem built on a submerged outcrop of granite.

Q: What did Jeff say when Roxanne asked him how he knew it was granite? (1 mark)

My swimming club installed a reef monitoring camera and we retrieved a piece of rock when we secured the camera to the outcrop. It is granite because …

a. … it is fully crystalline and is mostly pyroxene and amphibole, with some olivine.
b. … it is fully crystalline and is mostly quartz and feldspar, with some amphibole.
c. … it is partially crystalline and is mostly quartz, feldspar and glassy groundmass.
d. … it is partially crystalline and is vesicular (full of bubbles).
e. … it is fully crystalline, with muscovite layers wrapping around garnet crystals.
f. … it is totally granular, with most of the grains being quartz or tiny rock fragments.

57. They walked over the flood basalt shore platform at Yara Point on their way to Jeff's camp near Cape Greyjoy, exploring rock pools and finding lots of interesting flotsam and jetsam on the way. They found many places where the gas bubbles in the basalt had been infilled with a white mineral. Jeff decided it was calcite after it scratched a piece of broken glass he found on the rocks.

Q: What did Roxanne say to correct him after inspecting the mineral with a hand lens?

a. This mineral has a hardness greater than 6. It is most likely quartz, given it has no cleavage and I can scratch it with the garnet on my keyring.
b. This mineral has a hardness greater than 6. It is most likely olivine, given it has no cleavage and I can't scratch it with the garnet on my keyring.
c. This mineral has a hardness greater than 6. It is most likely quartz, given it has only one cleavage and I can scratch it with the garnet on my keyring.
d. This mineral has a hardness greater than 6. It is most likely beryl, given it has no cleavage and I can scratch it with the garnet on my keyring.
e. This mineral has a hardness less than 6.5. It is most likely olivine since it is in a basalt rock and I can scratch it with the garnet on my keyring.
f. This mineral has a hardness less than 6.5. It is most likely fluorite, given it has four cleavages and I can scratch it with the garnet on my keyring.

58. Before setting up camp for the evening, Roxanne and Gemma walked to Cape Greyjoy with Jeff to catch the sunset. Standing on the elevated Cape's outcropping grey rocks and admiring the view across Stark Reef, Gemma was puzzled by the rocks underfoot that looked like laminated mudstone. She wondered how these rocks could form an elevated headland in such an intense erosional environment.

Q: How did Roxanne explain this to Gemma's satisfaction?

a. The rocks were originally laminated mudstones that have been emplaced by faulting. They resist erosion because the energy released by faulting has metamorphosed them.
b. The rocks were originally laminated mudstones that now resist erosion because the overlying flood basalts have metamorphosed them.
c. The rocks were originally laminated mudstones but were intruded by the granite now supporting Stark Reef, forming a hard metamorphic rock that is very resistant to erosion.
d. The rocks are laminated mudstones. They resist erosion because clays are harder to erode from an outcrop than sand or silt sized grains.
e. The rocks are laminated mudstones held together by oxidised graptolite fossils.
f. The rocks are laminated mudstones baked hard by exposure to sunlight.

Back at camp.in the evening, they sat around the fire enjoying dessert (Jeff was having fish-flavoured ice cream as usual) while star gazing and exchanging messages with friends elsewhere in the solar system. Gabi and Rose, still on Titan, mentioned they could not see stars because Titan's atmosphere was too hazy but said they did get some great views of the Milky Way on their outbound journey while they trained high performance instruments on Earth's closest known exoplanet systems. They were especially interested in Tau Ceti (T Ceti) because it is our closest solitary G-class main sequence star (Figure 34) with a system of potentially Earth-like rocky planets.

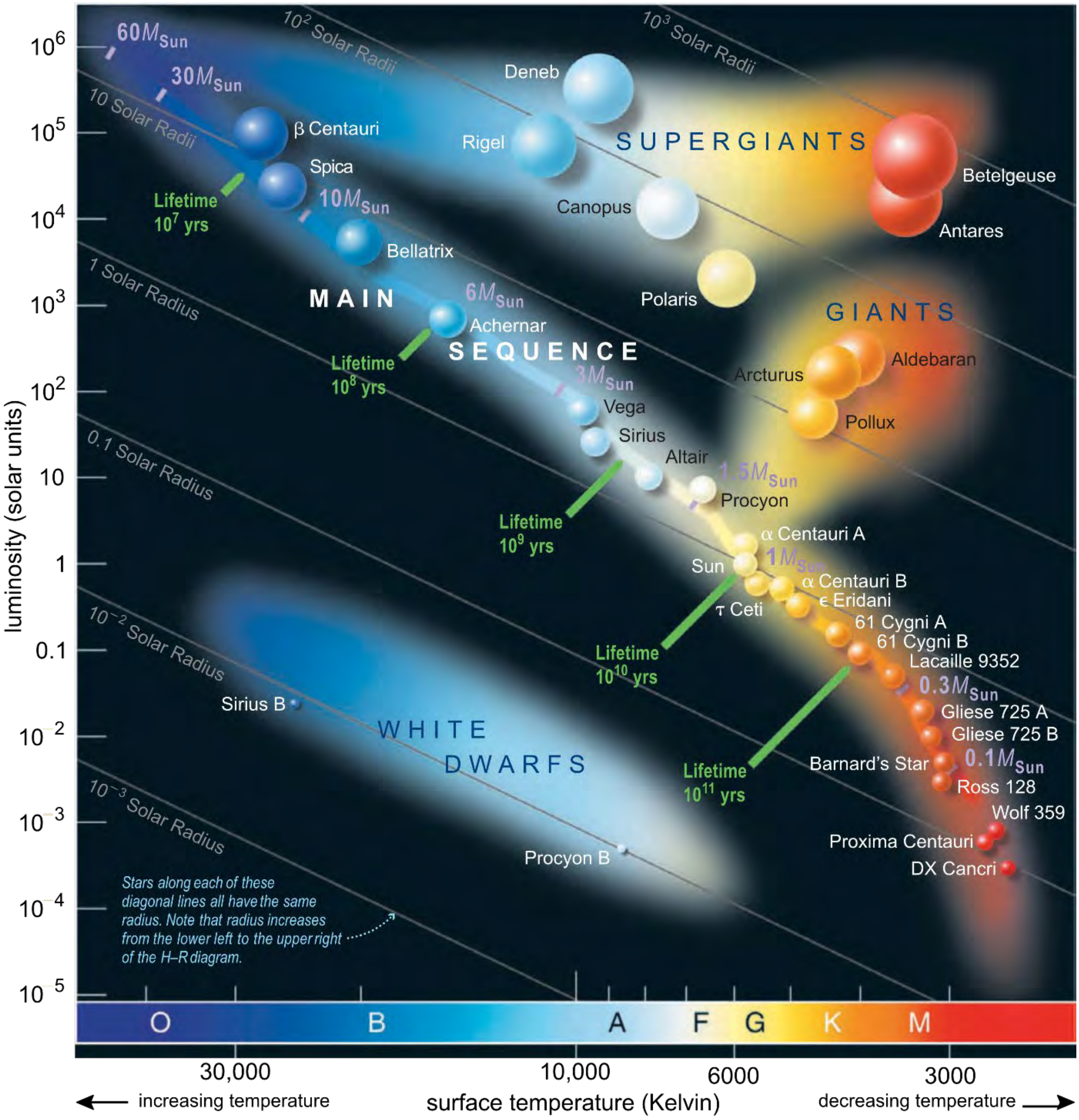


Figure 34: A Hertzsprung-Russel diagram.

Modified from Cosmic Perspectives; Bennett, Donahue, Scneider and Voit 7th Ed.

59. Traci, their palaeontologist friend, was curious about the significance of T Ceti being a G-class main sequence star. She said it was accepted that life as we know it could only exist on planets where liquid water was present but the definition of a habitable zone – the orbital space around a star where liquid water could exist on planets – applies to all types of stars, not just one class.

Q: What did Zoe say to help explain their interest in this class of star?

When they moved to Mars, Noelene Ambergris, the inventor of WaterPIPE™, wrote:

> *Mars is barely habitable because of the thin, oxygen-free atmosphere, low temperatures and lack of a protective magnetic field. We can and have engineered our way around these problems. However, we still have our Sun, shining the light all Earth life has evolved under down on us. We can't engineer or terraform our way around that if we also want to walk freely and grow Earth's plants wild on the surface of the planet. Those who eventually choose to migrate beyond our solar system will have the same issue. Liquid water should only be the first of many criteria that define habitability.*

This this is now known as the Ambergris Doctrine. Many of the exoplanet systems we have found are orbiting red dwarf stars such as Proxima Centauri and Wolf 359.….

a. …The habitable zones for these cool-low-luminosity star systems must be very close to the stars, suggesting the planets might be tidally locked (one side always facing the star) with very short orbital periods. Life is not impossible there but the physical setting and the spectral properties of the star's light are not attractive for human settlement as per the Ambergris Doctrine.
b. … The spectral properties of G-class main sequence stars and the physical setting of the habitable zone make them attractive for human settlement as per the Ambergris Doctrine.
c. …However, we know all rocky planets orbiting G-class stars are habitable and such systems are therefore far more attractive for human settlement as per the Ambergris Doctrine.
d. …However, we know all rocky planets orbiting G-class stars develop Plate Tectonics – an important ingredient for life – and this makes them far more attractive for human settlement as per the Ambergris Doctrine.
e. Both a) and b)
f. All of a), b), c) and d)

60. Traci was also curious about exoplanets orbiting giant stars and whether any of them could be of interest for human settlement.

Q: What did Zoe say in response?

Our focus has been on main sequence stars; however, we have found giant planets orbiting Pollux and Aldebaran so they could have smaller rocky planets too. That said, the giant stars are over ten times the diameter of the Sun and much more luminous than F, G, K & M class main sequence stars.

a. This means the habitable zones will be much further out from the star.
b. This means any planets in the habitable zone will have extremely long orbital periods.
c. This means any planets in the habitable zone will have extremely long seasons, assuming the orbits are elliptical.
d. This means any planets in the habitable zone will have extremely long seasons, assuming they have an axis of rotation tilted at an angle to their orbital plane.
e. Additionally, giant planets in the habitable zone, create the possibility of Earth-like and Titan-like moons orbiting the giant planets, effectively placing them in the habitable zone too.
f. All of the above.

As the evening progressed, they played their favourite True / False game with each other. See if you can match them as they challenged each other with quirky truths and false facts. Can you do as well as them in picking fact from fiction?

61. Gypsum is the softest mineral.
True or False (0.25 Mark)

62. The Benioff Zone is found below a Mid-Ocean Ridge.
True or False (0.25 Mark)

63. Earth is 7.6 billion years old.
True or False (0.25 Mark)

64. The parent of a metamorphic rock must be a sedimentary rock.

True or False (0.25 Mark)

65. Io, Europa, Ganymede and Calisto are all moons of Jupiter.

True or False (0.25 Mark)

66. The Australian mainland has no actively erupting volcanoes.

True or False (0.25 Mark)

67. Shale and slate are two words that describe the same sedimentary rock.

True or False (0.25 Mark)

68. Antarctica is surrounded by subduction zones.

True or False (0.25 Mark)

69. The Earth wobbles on its axis, and makes seasonal contrasts more extreme in one hemisphere and less extreme in the other over a span of about 26,000 years.

True or False (0.25 Mark)

70. 375 million years ago, the Earth's tectonic plates were in the same position as they are now thanks to the cyclicity of plate tectonic motion.

True or False (0.25 Mark)

71. If you are having a gneiss day you have also experienced high grade metamorphism.

True or False (0.25 Mark)

72. A fossil is any evidence in rocks of a once-living thing from a past geological age.

True or False (0.25 Mark)

73. An ore is a deposit from which a metal or other valuable material can be extracted profitably.

True or False (0.25 Mark)

74. An unconformity is a break in the sedimentary rock record indicating a period of erosion or non-deposition.

True or False (0.25 Mark)

75. Iceland is formed by a hotspot (mantle plume) rising beneath a mid-ocean ridge.

True or False (0.25 Mark)

76. Earth's sunset colours are partially controlled by the amount of volcanic ash in the stratosphere.

True or False (0.25 Mark)

77. All non-avian dinosaurs are extinct.

True or False (0.25 Mark)

78. Despite being the same size as Earth, Venus is not a rocky planet.

True or False (0.25 Mark)

79. The largest volcano in the solar system is on Io.

True or False (0.25 Mark)

80. Titan's methane-ethane atmosphere is not flammable on Titan.

True or False (0.25 Mark)

As the Moon rose on Earth, they decided to call it a night and bid farewell to their far-flung friends until next time.