**Oman Drilling Project - GT2 – Lead Scientist On-Site Log (LSOS). From 24th Dec 2016 to 21st January 2017**

This is an electronic version of the Blue Book that Juerg Matter and Michelle Harris started, and Damon Teagle continued. He thought would be more useful as an electronic log.

**GT2 22.86320N, 058.51998E, Altitude 618 m (+3 m).**

Inclination of Hole GT2A. 60 deg. Trend 060. Note the drillers’ zero is a greasy mark on the top drive track about 3 m up from ground.  (See photo)

***Take Home Messages and Major Issues***

1) Uppermost hole. Highly porous. Need deeper casing (>10 m?, use weathering and oxidation of core to guide 100 mm casing depth). In hindsight it might have been worth risking pulling the casing and inserting longer casing after say 50 m with no fluid return. It would have been risky but if successful might have enabled us to drill more deeply with HQ. Something to think about for future holes.

2) Even deep (>50 m) crust is highly permeable and could be significant drilling fluid loss.  No fluid/drilling mud return at 150 m! (but could be lost in shallow subsurface)

3) The core box saga.... see below. A long running and still unresolved problem.

4) We have had regular visits from MRMWR (Muscat and Ibra office), Zaher, but not a sniff from Sultan Qaboos University. There are some great projects that could be undertaken. Regional maps of boreholes - say 1km in all directions from sites. Even if it was wandering around with a GPS and compass-clino would provide a much better regional context for the boreholes.

Even though we are getting great core - inevitably there is much broken material on edges of fractures and faults that will rapidly become powdered in the core boxes. This material is currently bagged and in the coreboxes, but experience suggests these materials get lost or ground to dust in the boxes. I'm tempted to take back to Southampton for XRD and maybe other tests. But this would also be a great project for an SQU student(s) where they have an XRD. DT would gladly help supervise. It would be useful to identify calcite, dolomite, laumontite, Na-zeolites, prehnite etc as well as Smectite, Chlor-spec, chlorite, actinolite, epidote, clinozoisite, serpentine, talc etc.

5) Is it possible to rationalize the vehicles. At times we have 4 or 5 land cruisers when we need two. Can someone find a long-distance taxi/car service who could shuttle people from Muscat International to Ibra.

**DAILY UPDATES**

**21st January 2017, Saturday** LSOS Jude Coggon/Benoit Ildefonse

Finish setting up GT1 site; transport items from GT2 to GT1, pitch tent etc.

**20th January 2017, Friday**

No work onsite, weekend

**19th January 2017, Thursday** LSOS Jude Coggon/Benoit Ildefonse

Onsite staff: BI, JC, SM, AJ,

Science team and Nehal spent day sorting boxes and lids.

Rig moved to GT1. Rods and other accessories also moved. Mud pits filled in.

Science team wrapped up boxes in tarps to protect from possible rain. Took tarp down and closed up tent.

**18th January 2017, Wednesday** LSOS Jude Coggon/Benoit Ildefonse

Onsite staff: BI, JK, JC, SM, AJ, DGS

07:23 Onsite, already rotating, pulling out drill rods.

Science team completing logging and curation of final cores.

Beginning to change lids so that box and lid match for each box. Dark blue lids are not a great fit on dark blue boxes. Light blue lids and light blue boxes are much better fit.

14:50 update from Wali: after trying to deepen the surface casing another 6 metres, he stopped after 80cm because the pressure was rising and not safe. He will now pull out the NC casing, we will have at the end a 6.8m surface casing of HW size.

15:30 SM took JK and DGS back to apartment as they fly out tonight.

Packed up site and continued lid-matching process.

17:00 finish

**17th January 2017, Tuesday** LSOS Jude Coggon/Benoit Ildefonse

Onsite staff: BI, JK, JC, PK, SM, AJ

07:20 Onsite, rig already started

JC has gone to GT3 with PK this morning, back on site at 14:30.

**GT2 complete!**

Abundant pyrite again in ol-rich interval at top of core 146. White veins (laumontite, gypsum….?) are often seen swollen eg bottom of 146-4. Core 148 is entirely altered to greenschist facies with abundant epidote in the groundmass, several faults, well cemented. Numerous veinlets of sulphide (pyrite, chalcopyrite?).

**16th January 2017, Monday** LSOS Jude Coggon/Benoit Ildefonse/

Onsite staff: BI, JK, JC, SM, AJ, DGS

07:10 Onsite, already rotating

1.61cm long piece in core 137, the longest for this team.

138Z has thickest sulphide veins so far, up to 3mm thick.

138Z vug caused great excitement!

Question: do we keep the few cores that have been stored in light blue boxes in those boxes? To avoid transfer in other boxes and risk to break/damage cores?

11:55 Rig stopped, no water, waiting for next truck, depth is 368.4m

12:13 Rig started, adding a new joint, truck arrived 12:16

Bigger water truck now ~5000 gallons (other truck = 2000 gallons), Nehal thinks 2 deliveries per day from 5000 gallon truck will be sufficient as drillers need 6000 gallons/day.

Drillers supply = 3 x 800 gallons + 1000 gallons + 2 x 500 gallon pits – total = 5000 gallons.

12:20 Rotation started

Troctolite layers are back in core 141 (~370m). Troctolite layer in core 142-2 got out shattered from the core barrel. Abundant pyrite with altered olivine.

15:59 Core catcher failed at recovering most of core 143 (only 78cm recovered) – sleeve partly out. 2nd run to retrieve the rest of the core (advance was 3m). Next COD at 16:18

16:53 Rig off.

**15th January 2017, Sunday** LSOS Jude Coggon/Benoit Ildefonse

Onsite staff: BI, JK, JC, PK, SM, AJ

07:15 Onsite, rotation started 07:25

17:00 Rig system pressure 180 kgcm-2; pull down 20 kgcm-2

127Z having trouble again with collecting full core. Seems to be an issue with the core catcher – drill bit relationship/connection. Spoke to Wali: issue was that bottom of core was fractured so collected in core barrel but fell out in transit to surface and twisted around in drill rod/drill string and got stuck somewhere between surface and bottom of hole. First attempt to recover failed so had to ream, advanced ~5cm in order for CC to have something to latch onti, ie plug bottom of core barrel. Final section recovered on deck at 09:04.

10 visitors from MRMWR and Divan Royal Court- PK gave intro to project and scientific goals, then tour of GT2 site, including watching a core come up to be received and reconstructed. Watched core be cut (as too long for box) and tour of rest of core flow. PK took them to GT1 site to see drill pad and explain further.

Need geological maps printed and onsite (laminated).

BI core 134Z is really really altered – greenschist facies and faulted. PK “beautifully altered”

17:40 Rig off

We continued recovering olivine gabbro with generally well defined magmatic foliation, and frequently strongly altered to greenschist facies. Cores 134-135 (~350m) contained abundant fault intervals, sometimes poorly cohesive.

**14th January 2017, Saturday** LSOS Jude Coggon/Benoit Ildefonse

Onsite staff: BI, JK, JC, PK, SM, AJ

07:25 Onsite, rig already started

09:55 Rig system pressure 170kgcm-2; pull down 25 kgcm-2

Boxes to arrive tomorrow, Sultan will go to try and expedite customs process.

Core 120 -> relatively strong greenschist facies alteration, higher than the average seen in cores since Jan 12th

11:17 First attempt at recovering core 122 failed, core catcher is broken, just a small piece in core catcher, another run to retrieve core, piece was stuck in core catcher and broken on deck.

Zaher visited the site.

Lots of re-drilled pieces in core 122, with none cylindrical shape.

Zaher & PK to GT1

Jude & Sultan discussion about drilling rate, Friday working and next hole:

1. Sultan explained that his workers may be able to work for 3 hours every Friday, but have to be paid double time to do so. His contract with Lalbuksh is for 6 days/week. Lalbuksh need to pay his company more if drillers have to work Fridays, Zaher is trying to resolve this.
2. Sultan has asked Wali to drill at a faster rate, but Wali said this isn’t possible at this hole, maybe next hole will reach 30-35m per day. I stressed many times that our priority is core quality not core recovery rate! Peter and I will talk with Wali directly to make this clear.
3. Sultan says that if vertical the next hole will be much quicker to drill…(PK & I will check what Wali says about this). He also says that Geosolutions contract with Lalbuksh states 400m HQ/NQ. He seemed surprised that we expect HQ to 400m, and that this is in our contract with Lalbuksh. According to Sultan to drill HQ to 400m need to start with PQ (NB would cause delays, need converter for drive head plus PQ rods). Would need to drill PQ to 50-60m, case and then change to PQ, and then might still need to change to NQ. Can Chikyu handle PQ core?

Zaher spoke to guy who keeps goats on road to GT1 – outcome of conversation?

BI & JC spoke to Wali, BI reiterated that we know his managers are pushing him to go faster, but that we agree with him that his approach is right and best, take care of core quality and hole stability.

JC asked if vertical hole is easier/quicker to drill, Wali explained about deviation due to gravity acting against our inclined hole. Says easier and quicker to drill vertically as centre of gravity is hole. We will inform him if we plan to vertical hole at GT1. JC asked can we drill with HQ to 400m (as in contract with Lalbuksh) Answer in theory this is possible but would need casing (PQ?) to 200m. In these rocks (4-5 fault zones so far this week), Wali’s recommendation is to drill to 200-210 m with HQ and then switch to NQ. He doesn’t want to get the equipment stuck in the hole.

[In tent with other team members present]:

Wali has also told us that when this hole is finished (400m), before pulling the casing (150m) he will ream the hole to install SW casing for another 6m (12m total) as he knows from Juerg that cameras & logging equipment need to be deployed in the well later. Nehal is concerned that cuttings from this process will fall down the hole, Wali says not as casing to 150m will still be installed so everything will get pulled out. Nehal seemed happy with this.

126Z-4 collected in second run of CC for this core, BI & PK agreed should be last section of 126Z and not new core.

We continued recovering essentially olivine gabbros displaying a strong magmatic foliation, but generally more altered than those cored on Jan 12. Alteration ranges from HT assemblages with black amphibole to greenschist facies metagabbro. We observed the same vein combo – epidote, prehnite/chlorite, prehnite, serpentine, later laumontite veins appear to be much less abundant or absent

**13th January 2017, Friday** LSOS Jude Coggon/Benoit Ildefonse

Onsite staff: BI, JK, JC, SM, AJ

No drilling – rest day for drillers.

BI, SM, JC went to look at GT1 pad and plan layout of site.

**12th January 2017, Thursday** LSOS Jude Coggon/Benoit Ildefonse

Onsite staff: BI, JK, JC, SM, AJ

07:15 Onsite, rig already started

07:30 Rotation started

09:05 Rig system pressure 175kgcm-2; pull down 25 kgcm-2

08:30 Electrician back onsite to change the control panel on the saw

10:00 Got our screwdriver! Control for saw and water now on same switch

10:00 Rig system pressure 175-180kgcm-2; pull down 20kgcm-2

12:32 COD interval including 300m!

13:52 Rig stopped for maintenance and lunch

14:13 Rig started

16:45 Rig stopped

16:15 Were informed drillers won’t work tomorrow, have asked Gobi to resolve this, we will not be able to drill all 4 holes by end of March without 7 day/week drilling.

We passed 300m today, less layered gabbros and more foliated gabbros and ol-gabbros, some of which have spectacular magmatic foliation. Sulphide was abundant, associated with alteratoion of olivine in some of the olivine gabbros.

**11th January 2017, Wednesday** LSOS Jude Coggon/Benoit Ildefonse/Juergen Koepke

Rig started 07:05 Rotation started ~07:15

07:50 Rig system pressure steady @ 170 kgcm-2; pull down steady @20kgcm-2

11:35 Rig system pressure steady @160kgcm-2; pull down steady @20kgcm-2

13:48 Rig stopped, lunch break for drillers

14:06 Rig started 14:10 rotation started

16:35 Rig stopped

Servicing rig after last core.

Core 102Z is a nice layered gabbro core with layers of gabbro, ol-gabbro, anorthosite. Dunite and wehrlite. Pyrite veins in the dunite 102-3 (pictures taken). 106Z is more fine grained and less layered than this morning. Becoming more foliated. Quite fresh plagioclase = dark.

Another day in gabbroland! 21 more metres with spectacular layered gabbros followed by more homogeneous foliated gabbros. Drilling continues smoothly. In core 103-2: early vein with black amphiboles cross cut by prehnite veins. Black amphibole turned to hornblende at intersection with prehnite veins, this is a HT magmatic/metamorphic record of early hydrothermal circulation possibly on/close to the axis.

Boxes: Dark blue = diamant boart; light blue = Barcom.

Blue boxes (Diamant Boart) = 1080m x 340 mm x 69 mm with lids (59 without lids)

NQ diameter = 47.6mm, max 5m per box, but more like around 16m per 4 boxes.

**10th January 2017, Tuesday**

Rig started ~0715. Rotation started 07.25.

Rig system pressure steady @180 kgcm-2, pull down steady @30kgcm-2.

~11:20 rotating again after last core on deck (core 97) but only very slow rotation, drillers having break to eat.

11:40 rotation at normal speed restarted

13:45 rig stopped after core on deck and next red pipe attached, fiddling with oil canister thn they all disappeared ?lunch?

14:07 Rig started, rotation started 14:10

14:20 Electricians onsite since lunch to try and fix control panel of rock saw. We lost power to our supply for the tent, think work on saw was happening while still plugged in and caused fuse in multisocket extension lead to blow, confirmed at 14:36, changing fuse now.

14:40 power back on, cover on saw still not fixed, motherf\*%@\*rs stole our screw driver!

14:57 100th core on deck!

16:30 Rig off

The material recovered is generally layered gabbros, sometimes strongly altered in the vicinity of fault zones (up to 1m thick) or hydrothermal veins

**9th January 2017, Monday** LSOS Jude Coggon/Benoit Ildefonse

Rig started ~0715. Omani bunting added to curation tent. Some time spent adding a few centimeters of HQ liner (from 2.6 m to 3 m) to the top of the hole to reduce vibration. In the end, it wasn’t clear whether they actually did anything. Rotation at 0820. Continued until first core (87Z1 @09:55) principally because of a lack of drill water. A constant issue throughout the day. The hole is only returning ~20-30% of the drill water, so three or four tanker loads required. System pressure is 150 to 160 kgm2 but stable. Wali is confident that the hole is drilling well.

0952 – rotation stopped – no water; restart 1020

1200 – rotation stopped – no water; restart 12:35

Third delivery in mid-afternoon (this could be a big problem at GT-1). Rig off at 16:50 – and the drillers were off in a shot!

Core is excellent – we have been drilling through much fresher rock, clearly layered gabbro, but then into faults and shear zones (Jurgen/Samuel’s zone?). Much more of the hydrothermal signature that I’d expected – amphiboles, epidote, clinozoisite etc – rather than just laumontite (although that is still abundantly present).

7 cores pulled (87Z1-4 @ 227.4 m) to 93Z1-4 @248.4 m). 21 m of advance with 21.53 recovery. Unfortunately missed 250 m.

My last day at site. Core flow is very efficient and relaxed with 6 people (+Nehal), especially when one is Samuel and his network. OmanDP probably should buy a second toughbook.

The group currently on site who should finish this hole have discussed what to do if hole fails before 400 m. I think the general feeling is that we must push on to the 400 m, but that if the worst happened the cores recovered will still deliver excellent science.

We removed some of the sample bags of the chips and powders bagged during curation as NQ-lids were removed to use for core and replaced with ill-fitting light blue lids. Gave an opportunity to look at early cores drilled 25-26 Dec, 2016. Cohernet core starts in Box 6, Core 11, so ~14 m. Casing this interval might have helped.

**8th January 2017, Sunday.** LSOS Prof Damon Teagle

Rig started 0725 with first core at 0812. 10 cores were pulled today for a total advance of 30 m. 77Z1-4 to 86Z1-4 (197.4 to 227.4 m). Total recovered 30.71 m. Rig switched off at 16:25. Only minor rig delays. Note at 15:00 drilling Core 85Z torque is quite variable just less than 200 kgm2. Minor variation but need to keep watch during operation. Wireline time is ~6 minutes now (deeper hole and full of water). Just as I leave I think I’m getting my head around the “white minerals”

Most of the bright white minerals, sometimes forming prismatic rods in open spaces, are Laumontite (Ca2Al2Si4O12.4H2O).

I think the thin wispy veins – commonly with secondary plagioclase halos, are prehnite. These often may occupy earlier veins of actinolite/Mg-hornblende but these phases are rare in core.

Gypsum IS present but is very soft and appears translucent. Need to do a global change of gypsum to laumontite except for first mention.

There also some carbonate present and quartz/silicification in some shearzones.

**7th January 2017, Saturday.** LSOS Prof Damon Teagle

First at site 0710. Rig start 0733. Rotation 0740. The B-team are smoothly efficient. 9 cores pulled (68Z1-4 to 76Z1-4) for 27 m advance with 27.35 m of recovery. Only minor rig stoppages. These are some of the freshest gabbros we’ve seen, perhaps the first rocks any self-respecting igneous petrologist would work on. But 5-10 mm “gypsum” veins are still common (see notes next day). Wonderful layered anorthosite – troctolite gabbro in 96-3 (as featured in daily photograph). Probably the best days coring on site to date. B-Team have kept up with core flow. Wireless network, power to logging table and file copying on site greatly improves efficiency.

Nb – the term “Anorthosite” added to rocktype list in DIS (by SM & JC). There should be a global replacement of “plagiogranite” for “anorthosite” as former term used as closest match for a “white rock”.

**6th January 2017, Friday.** LSOS Prof Damon Teagle

At last we are back to coring. Rig powered up at 0710 with rotation from 0730. Ist NQ core of GT2 at 0823. Initial 2.7 m advance (2.67 rec) to balance rods. Eventually 7 cores pulled 61Z to 67Z from depth interval 149.7 to 170.4 m. An advance of 20.7 m with 20.90 recovery. Rig stopped at various stages for maintenance; break after 62Z (to 0920), Maintenance after 64Z (to 13:12), rig stopped after 65Z to 1425.

An exhausting day but new team and new streamlined coreflow kept pace with incoming..

Wali (Chief Driller) estimated water table in hole to be at 67 m.

Attached indicated GT2 will be completed sometime between 15th and 22nd of Jan…

**5th January 2017, Thursday.** LSOS Prof Damon Teagle Project)

Rig started 0745.HQ-NQ adapter constructed overnight. Rotation at 0750. Pulled core/core barrels 59Z (20 cm advance) and 60Z (10 cm advance) – but empty. High fluid pressures and no core. Good return of drilling fluid. An issue with core entering core catcher. Need to check bottom hole assembly. Trip out NQ pipe and bit. It appears bit and core catcher are from the same manufacturer but not of the same series. Claimed the right equipment was in Ibra but of course was in Muscat. So the site sat idle until Mr Anas Al-Sulaimani (Zaher’s youngest son) turned up with his “phantom” drone and we flew it around GT2 taking both vertical and aerial oblique shots. Also went down to GT1 for similar.

Assured that there will be core tomorrow.

**4th January 2017, Wednesday.** LSOS Prof Damon Teagle

A frustrating day. No cores drilled, no advance. NQ drill-string is in the well but whole day wasted because drill crew couldn’t release the HQ spindle from the top-drive so that it could be replaced with a NQ spindle that fits the NQ rods. One of the large wrenches was broken this morning, and much of the day was spent trying to get a workshop in Ibra to make an HQ to NQ adaptor. This process was still not complete by the time I left the rig site at 1745 with assurances that it would be put right by the morning. A Cummins Diesel engineer was also on site for much of the day servicing the rig engine. It is not clear to me that they have established the reasons for the overheating a couple of days ago.

Early part of morning used to train new arrivals (Prof Juergen Koepke and Samuel Mueller) in the core flow, scanner and other procedures. All HQ cores drilled from GT2A now curated, described, scanned and boxed up.

Samuel has brought with him a second ruggedized PC that he can leave with the Oman Project until Spring. Multiple user requirements of the ToughBook that hosts the ICDP-DIS database and other software cause some interruptions. OmanDP has purchased a wireless router (RO18) and Samuel is setting up the ToughBook as a server with clients, so that the tablet, core scanner computer and the other ruggedized PC can interact with the database. We will then be able to transfer files between computers (e.g., from scanner to ToughBook) wirelessly without using USB sticks etc. Once set up it should be simple to use, and Samuel is here for ~3 weeks to trial.

**3rd January 2017, Tuesday.** LSOS Prof Damon Teagle (Co-Lead PI Oman Drilling Project)

Only 1 core pulled today, ~30 cm drilled to balance rods. Recovering a short piece of altered gabbro. Total depth 149.7 m. Day principally spent pulling out HQ rods and bit, and inserting a liner of old HQ rods with casing shoe, and re-entering hole with new NQ bit and NQ rods. Science team caught up with curation, scanning and descriptions. Prof Juergen Koepke and Samuel Mueller arrived 1530. Michelle Harris and Dominick Mock left ~1900 for Muscat airport.  DT screwed up reporting to ICDP. (actually he didn’t - error was the use of an “&” in a text stream for the photo caption, rather than “and” – this is too much for DIS to handle…)

**2nd January 2017, Monday.** LSOS Prof Damon Teagle (Co-Lead PI Oman Drilling Project)

Major downtime today with rig issues especially a problem with the thermal cut out on the main rig engine (Cumins) requiring extended maintenance.  Replacement of dirty fuel filter seemed to fix problem (there had been a lot of blue smoke on morning start up).The hole is still losing a huge amount of water and 0% of drilling fluid is being returned. This is resulting in rising torque (System pressure) on top drive. This should be ~100 kgm-2 and steady. For most of the day this was >150 kgm-2 and at times >200 kgm-2. Wali/Wali (Chief Driller) is not happy and thinks it is important to restore circulation. Plan is to remove HQ rods and bit, re-enter with old HQ rods with casing shoe as liner down to full depth (~149.7 m) and then drill ahead with NQ. This closed circuit should allow better clearing of cuttings and better conservation of water and filling fluid. Water supply remains an issue with few (no) deliveries in the afternoon. This could be a major problem at GT1.  Only 5 cores pulled today

12 m advance rec 12.6 7m

We started using temporary wooden HQ boxes from Box 50 (50, 51, 52)

Took Nehal down to GT1 site and looked at target Cu-mineralised fault zone.

Core Boxes:

Lids are manufactured for the blue Diamanté Boart (societe anonyme) {avenue do Pont de Luttre 74, B-1190 Brussels, Belgium} HQ and NQ boxes.  DT is not keen on moving the curated cores into the white boxes should they ever arrive. Huge tedious job not and will further damage core. Note that the base of the white boxes is of a much more brittle plastic although grey lids appear to be polypropylene (?).  The white boxes have NO manufacturer's label or part number suggesting they are illegal copies of international product.

Lalbuksh have supplied some temporary wooden HQ boxes that allowed us to keep curation and storage of cores. These WILL need to be changed before shipment.  There has been very little  progress with the core box issue and a lot of obfuscation (bullshit?).  part of the problem is a complex communications chain from OmanDP-Lalbusck\_Geosolutions-local Agent-international supplier.  If we can get hold of this product we should purchase ourselves.   Assuming 70%, if we are to drill four x400 m holes this season (GT2, GT1, GT3, BT1) then we need A store of 280 HQ (4 section) and 280 NQ (5 section) core boxes. With replenishment as balance of HQ to NQ drilling evolves at each site.

I have asked of some temporary wooden lids for the HQ blue boxes to be made locally (see template).

**1st January 2017, Sunday.** LSOS Prof Damon Teagle (Co-Lead PI Oman Drilling Project)

The New Year was welcomed with good core but the impending issue of no boxes to store the HQ core....  8 cores were pulled today.  Rig powered up soon after 0700 and first (short ~1m) core pulled at 0735. Curation and core description on a single computer causes a major bottleneck but we keep pace with Michelle, but will be challenging with a less experienced crew. Need to find permanent solution to MS Office "activation" issues on Tough book and Tablet. This can be done by logging into Southampton VPN (use basic Southampton e-mail address, e.g., daht@soton.ac.uk) at least once a week.  A fix is supposed to be sent by UoS iSolutions.  Tablet can now be used to print piece labels.

Rock saw now working well (not dripping away water from tray. Nozzles better directed towards blade) but still requires circuit breaker pushed in with electrical safety/continuity screw driver.

Dinner with Gopi, Nehal and Sunil - Turkey Crystal - enjoyed Turkish Family meat feast platter.

Coreboxes have become a real issue. 49 blue plastic boxes were available but no lids, although these are manufactured. We have been using NQ boxes as lids for fully curated cores (also 50 NQ boxes available).  With continuous but fractured core, and ICDP curation requirements (new core starts at top of section) it is difficult to fill more than 70%.

**31st Dec 2016 Saturday,**LSOS Prof Damon Teagle (Co-Lead PI Oman Drilling Project)

NB Major cock up. Somehow piece labels became marked with Hole 1A - not 2A as is correct for GT2A.  Core boxes labelled to highlight this mistake. Pieces have NOT been relabelled.

On-site 07:00. Rig powered up by 07:20 and rotation from 07:37 following water deliveries. 8 cores pulled.

We have encouraged the drillers to start rig earlier so to pull first core at ~0730 rather than after 0800.  Rocksaw is now in better condition with water improving lubrication during cutting.  This will allow us to pack core boxes more efficiently.  Zaher visited ~1300and spoke with contractors (Lalbusk) and sub-contractors ("Geosolutions"). ZS will try to source some 10% HCl and small sample pots. He may come out next week to survey GT1, GT2, and GT3 with drone. Curation, scanning and description just keeping up with core flow. We probably could manage ~30 m per day especially if evening database activities were more streamlined.  Celebrated hole passing 100 m with Twitter photo.

 31st Dec 2016

TIME CORE-SEC

INT TOP INT BOT

ADV REC

REC%

08:37 33Z1-4

80.40 83.40

3.00 3.14

TOTALS Adv 23 m, Rec 23.54 m, Rec%, >100%.

End of Oman Drilling Project operations for 2016.

**30th Dec 2016 Friday**, LSOS Prof Damon Teagle (Co-Lead PI Oman Drilling Project)

Rig started at 07:22 with rotation from 08:00. First core at 08:37. 4 cores were drilled before drill team left for Friday Prayer. Note rig was idle from 10:20 to 10:45 for maintenance.  Science team stayed on site until ~14:30 catching up on curation and scanning. Teagle and Harris made GPS maps of GT2-GT1-Ibra-Highway23- OmanDP HQ in Ibra. We hosted visitors from Ibra Ministry of Regional Municipalities and Water Resources Ibra office including SQU Geology graduate (Name somewhere). Pakistani mutton curry for dinner.

30th Dec 2016

TIME CORE-SEC

INT TOP INT BOT

ADV REC

REC%

08:37 33Z1-4

80.40 83.40

3.00 3.14

TOTALS

**29th December 2016  Thursday**, LSOS Prof Damon Teagle (Co-Lead PI Oman Drilling Project)

Drilling started with Core 24Z (53.4 m) and we drilled through to 34Z (80.4) for an advance of 27 meters. Total core recovery 28.1 m (recovery% ~104%). Beautiful core, highly altered with very abundant hydrothermal veins, breccia, and faulted cataclastic layers (dipping). Very few missing intervals but areas of faulting resulting in crumbly friable cores. A number of highly mafic zones of resinous chlorite or serpentine plus pyrite. (I don't think I've seen a "fresh rock" yet!

Most surprising is the very high fracture porosity of the hole, with common open spaced filled calcite (+ ??) in voids (dissolution?) Hole continues to lose water  requiring 3 to 4 deliveries a day at least. Oxidation of fractures and fault gouges is still present but much less than it was higher in hole.

Late in day we learned that the drillers (sub-contractor) were not expecting to work on Friday and had not been instructed to drill 7 days a week. Following communications with Zaher and Juerg Matter, **sub-contractors have agreed to work a 1/2 day Friday (until ~11 am). This is to be resolved next week.**

29th Dec 2016

TIME CORE-SEC

INT TOP INT BOT

ADV REC

REC%

TOTALS

**28th December 2016, Wednesday.** LSOS Dr Michelle Harris

Operationally today went smoothly with 8 x 3 m advances until drilling water supply ran out just after core 23Z at 15:00. Drilling then stopped for the day. Core recovery continues to be high and several pieces >1 m recovered (Current record 1.85 m). 2 samples were taken for thin sections. Database issues partially resolved. Box labels are now working. Some further clarification on imaging is needed. Also an issue with sample labels.

Cores are mostly foliated gabbros although foliation is not well developed everywhere. Hydrothermal alteration is dominant visible feature especially abundant veins (Calcite, zeolite).  Borehole continues to lose large amounts of water. This has implications for GT1 and peridotite drilling. Will need more continuous supply (two tankers?) and better casing in the uppermost levels to establish circulation.

28th Dec 2016

TIME CORE-SEC

INT TOP INT BOT

ADV REC

REC%

**27th December 2016, Tuesday** LSOS Dr Michelle Harris

Start of day drill bit was changed before coring commenced. Advanced to 29.4 m (Cores 9Z - 15Z) with excellent recovery. Each 3 m core took about 1 hour. Core flow hectic but running smoothly. Cores included several intensely altered zones with some open space filling veins and vugs.  Prof Teagle arrived, and he and Dr Matter had quick handover including a short journey to GT3. GFZ-ICDP advised that unrolled core scans need further cropping/correction to how we are representing rubble intervals. Clarified via e-mail (MH to TG)

27th Dec 2016

TIME CORE-SEC

INT TOP INT BOT

ADV REC

REC%

TOTALS

TOTALS

**26th December 2016, Monday**, LSOS Dr Michelle Harris

Total water loss over night between surface and 7 m level.  Most of the day was taken up with installation of casing down to 6 m (SW Casing diameter: 100 mm diameter) in order to address loss of drilling fluid circulation (SEE LATER). A leak in a hydraulic hose caused further down time and required off site repair. Coring restarted at 15:00 and 3 short cores were recovered (Cores 6Z, 7Z, 8Z). Core 8, in particular, highly fractured, and intact pieces of core collapsed on removal from the core barrel. Core (and rubble) very sticky with drilling mud. Cores are a chlorite rich, highly altered alteration zone . Core flow was completed for Cores 1Z-5Z.

26th Dec 2016

TIME CORE-SEC

INT TOP INT BOT

ADV REC

REC%

TOTALS

**25th December 2016, Sunday** - LSOS Dr Juerg Matter

The new drill rig arrived early in morning. The first Oman Drilling Project core was received at 12:45 Christmas Day 2016.  By the end of the day 5 cores received (note: 3 m core barrel length). Initially drilling only 1 m advances. Record Drilling time was 2 m in 50 minutes.

25 Dec 2016

TIME CORE-SEC

INT TOP INT BOT

ADV REC

REC%

TOTALS

**24th December 2016, Saturday** - Lead Scientist on Site (LSOS) Dr Juerg Matter (OmanDP Project Director, and Co-Lead PI OmanDP)

Team Oman set up the core receiving tables, adjusted the tarp and tent. Several trucks arrived with drill rig, drilling equipment, water tanks etc. (WHAT AN AWESOME MOMENT after ~1 month)

1) Action on Site GT2 started after 4.5 weeks of on-site planning

2) Core scanner was transported from Ibra to Site GT2

3) Prof Eiichi Takazawa (Niigata University, Japan) and two students visited Site GT2

4) Core flow procedure was discussed with all team members (Dr Michelle Harris, Nicolas Bompard, Dominick Monk, Dr Juerg Matter).