PICO

# TECHNICAL SERVICES UPDATE

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This report summarizes engineering problems and accomplishments associated with the GISP-II program. It will be issued on a periodic basis to the NSF and other interested parties.

## DRILL MOTORS

As of last week, all the drill motors except two had been used and had failed after varying amounts of down hole use. The scenario for this situation is not entirely clear,but aspects of it point to the probable source of the problem.

Coring was begun with nine drill motors. The first drill motor lasted 27 hours at GISP before failure (in addition to a previous 10 hours at the CRREL test facility).Failure was due to shorting out of the armature. On being dismantled it was discovered that the motor canister oil had been drained for shipping and the motor was running essentially dry. A small amount of butyl acetate was also discovered inside the canister. This leakage led to the discovery that the O-rings which are used to seal the canister had been damaged during initial installation. It seems that the holes for the screws that hold the canister lid on had sharp edges which had cut the O-rings during installation. These holes had been deburred but apparently were still sharp enough to cause the problem. This first motor was also found to have non-butyl proof wiring which had been chemically attacked by the butyl acetate. All future motor wiring was replaced with butyl-proof teflon.

At this point it was discovered that no replacement O-rings had yet made their way into the field. Efforts were made by the field crew to seal the motor canister in other ways, but these proved ineffectual. Accordingly, the second motor was installed in the canister, the canister was filled with oil and coring proceeded. Motor # 2 failed after 16.1 hours down hole, again due to a bad armature.

Since the canister could not be sealed to retain the oil, it was decided to open both drain plugs and allow butyl acetate to circulate freely through the canister. This was done on the basis of last year's coring experience during which a motor ran nearly the entire season under these conditions. Motor # 3 failed after 23.3 hours for the same reason as had # 1 and # 2.

Motor failures continued, with the average running time being about 20 hours.

Communication equipment failure caused a week's delay in PICO UAF learning of the O-ring and motor problems. Meanwhile, most of the supply of drill motors was used up during the two ten hour shifts per day. O-rings and a few motors in the PICO UAF office were shipped immediately and new motors were ordered. Initial indications from the field were that complete new motors were needed. It was not learned that the motors were rebuildable until after orders had been placed for armatures through the SMO. This information simply did not come to the UAF PICO office. In fact, some of the telexes arrived in reverse order and as much as a week late.

No immediate indications were available as to the cause of the high drill motor failure rate. Assumptions were that the butyl was chemically attacking the armature windings and dissolving the resin on them. This may well be the case, but it does not agree completely with last year's experience. Apparently a good deal of carbon fiber particles in the form of dust were rubbed off of the new 6 meter inner core barrels during initial down hole run-in of this equipment. These particles are remarkably conductive and are well known to cause motor shorts and failures under other conditions. I see no reason why the same thing could not have happened here. These particles are denser than N-Butyl Acetate and would tend to collect at the bottom of the hole. It probably did not happen last year because the core barrels were only half as long and were probably a better fit initially, resulting in less wear and fewer particles. Conductivity tests were run on the butyl in the field with negative results, but this dosn't necessarily mean anything in this case. Only the individual particles are conductive.

No matter which scenario caused the failures, a sealed, oil-filled motor canister should eliminate the problem. Steps are being taken in the field to smooth the motor canister interior to prevent O-ring damage, and armatures, complete motors and O-rings are on the way.

As of the writing of this report, coring depth was 986.6 meters and the last drill motor was in use. One thousand to 1100 meters will probably be reached before the last motor expires.

CUTTERS

One other major problem has cropped up in addition to the drill motor failures. Cutters have worn out more quickly then anticipated due to a couple of reasons. One complete set of carbide cutters failed mechanically due to the carbide tip becoming detached from the cutter itself. Seven tips were lost down hole. This resulted not only in the loss of the use of these cutters but high wear rates on those remaining due to the presence of the carbide tips down hole.

As of the writing of this report, the last set of cutters was in use with the last drill motor. A 40 meter per day coring average was still being maintained.

**N-BUTYL ACETATE**

Interestingly enough, the supply of N-butyl acetate was originally scheduled to last until 1000 meters (including drilling after exhaustion of fluid). At present the supply is exhausted and coring will continue until the level of butyl in the hole reaches 300 meters or until core quality (which has been excellent to date) begins to deteriorate. The original estimate of the butyl lasting until 1000 meters appears to have been somewhat optimistic since recovery rates have been a bit lower then estimated and evaporation rates a bit higher. Chances are that a depth of 1000 to 1100 meters will be reached given present conditions. This converts to a better than 90% accuracy on the estimation.

Since the butyl supply has been exhausted almost at the time estimated, and it coincides with the requirements for motors and cutters, no serious setbacks are expected in the field schedule. In fact, the 10 days or so down time will be used for needed adjustments and maintenance on the 5.2 inch coring rig.

This time period will also be used for accomplishment of the 4 inch coring which has been authorized.

N-butyl acetate, 10 sets of cutters and 10 complete motors are scheduled to go in to camp on the flight period beginning July 22, 1991. O-rings and armatures will hopefully have already arrived by then. 5.2 inch wet coring will continue.

With regard to the need for ceasing coring at the 300 meter butyl level, several reasons present themselves:

(1) Core quality may deteriorate (it may deteriorate before the 300 meter level is reached) due to the fact that coring is still progressing through the brittle ice zone. Core quality will be monitored closely.

(2) Below the 300 meter minimum, calculations indicate that the hole will start trying to close due to a combination of overburden pressure and lack of drilling fluid head pressure. If this is allowed to happen, hole reaming would be required. Reaming operations would use more time and N-butyl acetate.

(3) If the drill should become stranded down hole due to winch failure or something similar, it is possible the hole could close too much to allow recovery. The possibility is remote due to ice temperature and equipment design. However it has happened to other ice coring operations in the past and must be considered.

Other more minor problems have occurred, but to date all have been overcome either by resupply or by inventiveness of the field coring crew.