

Sounding the depths

Paul Moore spoke to Adrian McDonald from The Oceanscience Group, about how its unique remotely operated survey boat has found a market in mining for bathymetry mapping of tailings ponds

Q Oceanscience recently announced that the Z-Boat is being used in Africa and elsewhere to accurately determine water volumes in mine tailings ponds. Can you provide an update on the Africa project, such as mine type and the feedback from the operator?

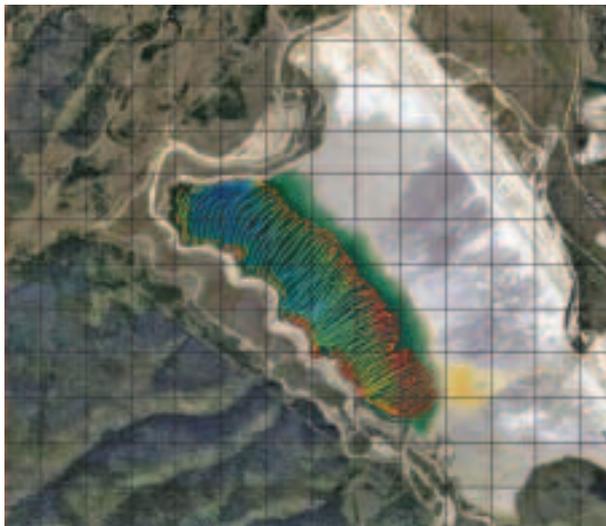
One of the first major mining operators to recognise the advantages that could be gained by using a remotely-operated survey boat, in this case the Z-Boat 1800, did not take long to move the technology outside the US. The third of the company's sites to turn to the Z-Boat for tailings pond bathymetry mapping was at a surface copper mine in the DRC. Although this site might not have been the best location for the Z-Boat trials, fortunately two successful start-ups at mines in the southwest of the US had been already completed before the mine in the DRC received their Z-Boat. At the DRC site, a survey pole and RTK GPS were being used to measure the water depth which led to poor coverage and even poorer volume estimation; there were simply too few data points from which to derive an accurate water volume estimate. By using the Z-Boat, the DRC surveyors gained a dual advantage: firstly moving from a manual measurement to an automatic sonar system with greatly increased data "ping" rate compared to point measurements and secondly being able to deploy the whole apparatus remotely and still cover the entire water area. The mine engineers were able to merge the new underwater bathymetry dataset with existing land survey topographic data to generate an overall relationship between the water surface elevation and existing/available water storage volumes. This relationship between water elevation and volume is an important component of operational security, especially in regions such as DRC where water events are particularly

challenging. Not knowing the volume of recoverable water in the tailings pond was a substantial data gap prior to the arrival of the Z-Boat. Currently, complete surveys are performed on at least a monthly basis to monitor the evolution of the tailings pond.

Q Is the benefit to the mine speed of surveying, safety, survey cost reduction or a combination of these?

In addition to these benefits, we have seen that the quantity and quality of bathymetric data generated is really the main difference between the pre and post Z-Boat surveying regimes. Reviewing a typical tailings pond depth contour map generated by the Z-Boat and estimating possible inaccuracies usually comes down to a very small fraction – just a few percent. The remote survey boat can cover the entire area of a tailings pond from bank to bank, and the sonar system can accurately and consistently detect the mudline. Even a dedicated survey boat with similar echo-sounding equipment is limited by its draft and cannot reach some parts of the pond. At each site the drivers for using the Z-Boat will be blended somewhat differently but one element is constant and that is the desire to reduce the risk to people at work and move them off the water. Mines in Australia are particularly keen to pursue the Z-Boat as a

Mapped results of a survey of a large mine tailing pond in the US with the Z-Boat



Close-up of the Z-Boat 1800

safety improvement, whether it is the mining operator or the contracted survey company's personnel.

Q CEE HydroSystems often provide the actual surveying instruments. Do you work closely with them and is the main input from Oceanscience bringing all the necessary components together for each individual project?

Different mine locations might require different echosounding equipment, and it is our job to bring the right technology to the mine whether this is a product from our technology partner or from a third party. The equipment on board may not necessarily be the most accurate or the highest specification equipment we can choose from; understanding the particular requirement of each site allows us to specify equipment that will do the job in a cost-effective manner. CEE HydroSystems developed sonar equipment that happens to be very well suited for remote survey vehicles, and with their location in Australia, they are very aware of surveying in the tailings environment.

Q Have there been any adaptations to the concept to make it specific to mine tailings applications?

Yes. The echo-sounder transducer – where the sound pulse is generated and later received - was brought into the hull of the boat and is no longer exposed to the water. Fortunately, the sonar can travel through the boat hull. This prevents damage from corrosive liquids and also reduces the risk during transportation that might be relatively challenging in the mining industry.



A Z-Boat mapping a tailings pond in Australia

Q Where there is a gradation between solids through high solids content slurry to water in tailings dams, would this present difficulties in generating accurate results?

With any echo-sounding method, unless the bottom is completely solid and consistent, for example like a concrete swimming pool, there is a degree of interpretation of the sonar result into what is deemed to be “the bottom”. The tailings environment does represent quite an extreme example of a gradual increase in solids content and the lack of a discrete “bottom”. Fortunately, sonar methods – whether on the Z-Boat or a survey launch - provide a consistent depth reading. The sonar can be set to record at a pre-determined echo response threshold that might be the very surface or it might be some way down into the deposited tailings but the depth will be consistent between measurements. The same cannot be said of a survey rod poked down into the pond! Suspended material may present issues, with high concentration of solids in the water column creating a false reflection. Fortunately, the sonar frequency can be modulated (low frequency is less prone to reflection) to gather bathymetry under these conditions.

Q Do you expect sales in mining to be mainly to specialist contractors like Swathe Services, or is there also a potential market in selling direct to mine operators themselves? Are you also talking to consulting groups with expertise in tailings management, such as Golder, SRK and Knight Piesold?

As the Z-Boat system is a relatively simple turnkey operation, we are seeing most interest from the mining operators keen to improve availability of bathymetric data without having to involve third party contractors. The mining consultant groups may or may not actually perform the tailings pond hydrographic survey;

this work is sometimes further sub-contracted to a hydrographic surveyor. The Z-Boat is being established as the principal remote surveying system not just in mining but in the hydrographic community as a whole so many survey firms already recognise that using the Z-Boat for their mine surveys allows them to meet safety requirements and reduce their costs.

Q In addition to the Z-boat are there other options for mounting of these types of instrument such as on a tailings dredge or pump?

Yes, the type of bathymetric survey equipment used on the Z-Boat is small and portable and often has self-contained data logging and power so there are few limitations. Usually, a geographic position is needed for every depth measurement and so the principal constraint is having a clear view of the sky for GPS satellite acquisition.

Q Is there also potential in mining in areas like surveying flooded open pit mines that are being pumped out and reopened or seabed surveying in shallow marine mining or dredge based mineral sands operations?

Yes and no. Deep steep-sided flooded pits present unique challenges but may be adequately surveyed with the correctly specified equipment. The current Z-Boat was designed as

an inshore survey boat which means that it is not suitable where waves approach 20-30 cm, a large wave on a tailings pond but a very small one on the ocean. Echo-sounders have a narrow “beam” of sound under the boat and excessive pitch and roll from wave action causes inaccuracy in the depth result. This can be corrected with motion sensors, which might be added to future Z-Boats should this become limiting in performance; so far it has not become necessary.

Q How is the Z-Boat protected from the corrosive and acidic nature of some tailings water?

The ABS plastic hull is acid and base resistant, and after removing the transducer from the water and installing it inside the hull, the only remaining area of potential concern are the motors. Chemical resistant seals and bushings are used so resistivity is good for the wearing parts, and combined with the relatively short exposure time and generous corrosion allowance the boat is well suited to long term use at pH <2.

Q Do you have any handle on the potential market size in mining for the Z-Boat?

The ratio of Z-Boats now in action on tailings or other mine reservoirs to the total number of inquiries we have seen is exceptionally high in the mining industry. Very few tailings engineers we have come across have found no potential value in the system. As the Z-Boat is such a good fit for the needs of the mine surveyor, we are now expecting the number of Z-Boats used in industrial water management to be not far behind the total number used by surveyors worldwide in natural waters, up to now our main market. *IM*



Mapping of a tailings pond in the DRC