Asteroid mining not a million miles away

June 11 2019, by Crispin Savage

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Work by a team of University of Adelaide scientists to perfect metal and mineral extraction processes is bringing the possibility of mining the wealth contained within asteroids closer to reality. But science fiction won't become fact until asteroid mining becomes economically as well as technically viable.

"Asteroids such as Bennu are closer to us than Adelaide is to Alice Springs, about 1000 kilometres away in Earth's near orbit," says Professor Volker Hessel, Deputy Dean-Research from the University of Adelaide's Faculty of Engineering, Computer & Mathematical Sciences (ECMS) and Professor in the School of Chemical Engineering.

"Advances in space exploration mean that these bodies which contain nickel, cobalt, and platinum as well as water and organic matter, are now within reach."

Professor Hessel is developing an intensified continuous-flow metal solvent extraction process which is faster and more selective than existing processes and is fine-tuned to the specific raw materials found in asteroids.

"Continuous-flow chemistry is proven technology. The process extracts metal by mixing and separating solvents. Successive passes of the chemicals through the process results in complete extraction of the metals," he says.

"Asteroid-born metals co-exist in different combinations and concentrations from those found in terrestrial rock, so one of the challenges that the team has is understanding how these may be successfully extracted. This new disruptive technology is needed as traditional technology does not provide the solution."

The continuous-flow technology is scalable and can operate in zero gravity and a vacuum which makes space mineral extraction a reality. Professor Hessel's US partner Space Tango is developing expanded flow chemistry capabilities in orbit. On 4 May they launched a mission that included, on board, the first processing lab assessing liquid separation. An array of space-focused companies is eyeing up the vast potential rewards on offer from the trillions of asteroids each worth millions of

dollars in raw materials.

"In the same way that colonialists and explorers exploited the resources of the New World about 400 years ago, today's pioneering asteroid miners are reaching out to exploit riches in space," says Professor Hessel.

"There are 17 missions currently underway for space resource exploitation. The NASA OSIRIS-Rex mission to Bennu asteroid will return with samples in 2023.

"Continuous-flow chemistry technology must be perfected to use as little water as possible. While launching costs are projected to fall in the mid-term, they will remain a serious point to consider. Instead of needing hundreds of tonnes of water to extract one tonne of metal, development of the technology may mean that less than 10 tonnes are required.

"Many alternative approaches are being investigated such as realigning asteroid orbits to make them more accessible, processing on the Moon, Mars or lower Earth orbit using available water, and processing on asteroids themselves or in the near-Earth orbit.

"Under the umbrella of the University's ECMS Faculty space theme and our In-Situ Resource Utilisation (ISRU) laboratory we aim to perfect metal extraction technology using continuous-flow chemistry. This is only one piece of our holistic approach to the in-situ resource utilization puzzle.

"Exploitation of the wealth locked up in asteroids will only become a reality when other disruptive elements come together and it is economically as well as technically viable," says Professor Hessel.