SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Novel Concepts and Technologies for Enable Future Building Blocks in Space Exploration and Development (3)

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A STUDY ON GEOPHYSICAL EXPLORATION STRATEGIES TOWARDS MINING ASTEROIDS

Abstract

In terrestrial mining, there are traditional and established strategies on how to explore deposits. Usually, a series of methods or types of instrumentation is applied. Therefore, their datasets can complement each other and enable a geological interpretation. The choice of an appropriate strategy depends on a series of key factors, such as the type of deposit, its location, its geological context, its assumed geometry and scale as well as the overall accessibility of the area. While there is a lot of experience with such actives on Earth, there certainly is not any in space. Currently, a wave of activities towards a resource driven exploration of asteroids is emerging. A new set of paradigms on how to explore such bodies differing from terrestrial strategies will eventually be required. An analysis of typical terrestrial strategies is presented, demonstrating that they are clearly not suited for asteroids. However, different conditions and most interestingly, different geometries, also offer new ways of using geophysical instrumentation. E.g. an asteroid allows to be flown around. Measurements can be conducted from all sides simultaneously. This significantly simplifies mathematical problems in data processing for some types of geophysical instrumentation. Furthermore, the paper provides a detailed survey on existing geophysical space instrumentation. While previous scientific studies on asteroids focussed on rather isolated topics, a resource prospection needs to take into account literally the whole body. A larger set of parameters needs to be investigated. Nevertheless, it is shown, what kind of existing technology could become part of such a resource prospection. The paper highlights issues, which need to be addressed for properly applying geophysical measurements. They include the need for a high precision navigation relative to the asteroid, the rather complicated surface contact, and restricted bandwidths for communication compared to the rather large datasets usually dealt with in geophysics. It is concluded, that all of those issues can be solved but require a lot of rethinking. An example procedure of how to explore an asteroid with an arrangement of two – or more – small space probes is explained. The example is intended to provide all input parameters that are required for further mining activities.