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Chapter 1 : Springer - books from this publisher (ISBNs begin with) (2 of 2)

This upsurge of scientific interest and research in marine minerals provided the impetus to organize an Advanced Research Workshop under auspices of the NATO Science Council and its Special Program Panel on Marine Sciences.

View All Biography Darius received a B. From , he was a postdoctoral fellow with the U. During this time he was also an adjunct professor and part-time instructor in the Department of Landscape Architecture at the University of Nevada, Las Vegas. His current research interests include the development of new methods and tools for the assessment and valuation of ecosystem goods and services - the specific benefits that we derive from nature. More specifically, his work involves developing methods and tools that can account for the spatial and temporal dynamics of service production and incorporate that and other information into more rigorous analyses of the tradeoffs associated with landscape management. National valuation of monarch butterflies indicates an untapped potential for incentive-based conservation. Moving across the border: Modeling migratory bat populations. *Ecosphere* 4 9 , p. A comparative assessment of decision-support tools for ecosystem services quantification and valuation, *Ecosystem Services*, 5: Comparing approaches to spatially explicit ecosystem service modeling: Ecosystem services valuation to support decision-making on public lands: A case study for the San Pedro River, Arizona. How do migratory species add ecosystem service value to wilderness? Calculating the spatial subsidies provided by protected areas. Model use, calibration and validation. Ecosystem services science and policy in arid and semiarid environments: Opportunities and challenges for the Colorado Plateau. *The Colorado Plateau V: Research, environmental planning, and management for effective conservation*. University of Arizona Press: Impacts of Climate Change on Ecosystem Services. Chapter 4 in Staudinger, M. Technical Input to the National Climate Assessment. Cooperative Report to the National Climate Assessment. Accounting for the ecosystem services of migratory species: Quantifying migration support and spatial subsidies. *Ecological Economics*, 70 A GIS application for assessing, mapping, and quantifying the social values of ecosystem services. *Journal of Flood Risk Management*, 3: A formal framework for Scenario Development to support environmental decision making. *Environmental Modeling and Software*, Martin, , An ecosystem services framework for multi-disciplinary research in the Colorado River headwaters. Geological Survey Scientific Investigations Report , p. North American Land Cover Summit. Formal scenario development for environmental impact assessment studies. *Environmental Modelling, Software and Decision Support*, 3. *Environmental Modeling and Assessment*, v.

Chapter 2 : Journal Titles and Abbreviations

A series presenting the results of activities sponsored by the NATO Science Committee, which aims at the dissemination of advanced scientific and technological knowledge, with a view to strengthening links between scientific communities.

In practical terms, thermodynamics not only allows us to predict what minerals will form at different conditions forward modeling , but also allows us to use mineral assemblages and mineral compositions to determine the conditions at which a rock formed thermobarometry. The calculations are often complex and are best carried out using thermodynamic modeling programs or programs specifically designed for thermobarometry. Phase diagram showing the reaction: Under normal earth surface conditions, the Gibbs Energy of this reaction is greater than zero. The result is that we can plot reactions on phase diagrams. Doing thermodynamic calculations requires reliable thermodynamic data. Additionally, although the calculations can be done by hand or with a calculator, they are complicated and time consuming. More information about fundamental thermodynamic calculations. Internally Consistent Thermodynamic Data Bases Thermodynamic data are obtained by calorimetry or derived on the basis of petrologic experiments , each with associated uncertainties. Combining thermodynamic values from different sources especially Gibbs Free energy values can lead to erroneous or misleading results because: Different workers have approached this problem in different ways, leading to the well-known datasets of Holland and Powell Holland and Powell reference list or of Berman Berman reference list. Fortunately, a number of different authors have created programs designed for calculating thermodynamic equilibria and making phase diagrams. Some of the most popular and complete programs are: You can also use it to calculate various activity diagrams. Thermocalc performs the same calculations as TWQ for a much larger number of phases and includes more complicated types of calculations that involve the effects of bulk composition on mineral stability. Melts is the only widely available program that allows thermodynamic calculations to be made for equilibria involving magmas. Perplex is a thermodynamic calculation package suitable for rapidly creating phase diagrams of all types, creating equilibrium phase diagrams pseudosections: Theriak-Domino is a suite of programs that can be used for calculating equilibrium phase diagrams pseudosections: The Results of Thermodynamic Calculations Phase diagrams are graphical representations of the equilibrium relationships between minerals or others phases. These relationships are governed by the laws of thermodynamics. Standard phase diagrams show how phases or phase assemblages change as a function of temperature, pressure, phase composition, or combinations of these variables. Some phase diagrams those for 1-component diagrams depict relationships involving multiple phases having the same composition for example, the relationships between the vapor, liquid and solid forms of H₂O. Other diagrams such as the one shown on the right , depict the relationships between a number of compounds having different compositions. Still others show how compositions of phases change under different conditions. More information about phase diagrams and examples. Thermobarometry Thermobarometry refers to the quantitative determination of the temperature and pressure at which a metamorphic or igneous rock reached chemical equilibrium. Many programs exist to facilitate such calculations, but most are only applicable to specific kinds of rocks and mineral assemblages.

Chapter 3 : CSIRO PUBLISHING | Marine and Freshwater Research

Discoveries of new types of marine mineral occurrences during the last decade, and specifically the massive sulfide deposits at spreading ridges on the ocean floor, have significantly advanced geologic concepts about the origin of ore deposits in a very short period of time.

The International Seabed Authority estimates that the total amount of nodules in the Clarion Clipperton Zone exceeds 21 billions of tons Bt , containing about 5. Growth and composition[edit] On the seabed the abundance of nodules varies and is likely controlled by the thickness and stability of a geochemically active layer that forms at the seabed. Nodule growth is one of the slowest of all known geological phenomena, on the order of a centimeter over several million years. Several of these processes may operate concurrently or they may follow one another during the formation of a nodule. A wide range of trace elements and trace minerals are found in nodules with many of these incorporated from the seabed sediment, which itself includes particles carried as dust from all over the planet before settling to the seabed. Almost half a billion dollars was invested in identifying potential deposits and in research and development of technology for mining and processing nodules. These initial undertakings were carried out primarily by four multinational consortia composed of companies from the United States , Canada , the United Kingdom , the Federal Republic of Germany , Belgium , the Netherlands , Italy , Japan and two groups of private companies and agencies from France and Japan. There were also three publicly sponsored entities from the Soviet Union , India and China. In the late-seventies, two of the international joint ventures succeeded in collecting several hundred ton quantities of manganese nodules from the abyssal plains 18, feet, 5. In the course of these projects, a number of ancillary developments evolved, including the use of near-bottom towed side-scan sonar array to assay the nodule population density on the abyssal silt whilst simultaneously performing a sub-bottom profile with a derived, vertically oriented, low-frequency acoustic beam. Sumitomo Metal Mining continues to maintain a small place-keeping organization in this field. On top of the environmental issues and the fact that the profits had to be shared, there was no cheap way to get the manganese nodules off the sea floor. There is also improved technology that could be used in mining including Pumps , tracked and screw drive rovers, rigid and flexible Drilling risers , and Ultra-high-molecular-weight polyethylene rope. Mining is considered to be similar to the potato harvest on land, which involves mining a field partitioned into long, narrow strips. The mining support vessel follows the mining route of the seafloor mining tools, picking up the about potato-sized nodules from the seafloor. Three factors were largely responsible: At this time, the commercial extraction of polymetallic nodules was not considered likely to occur during the next two decades. The International Seabed Authority has granted new exploration contracts and is progressing development of a Mining Code for The Area, with most interest being in the Clarion Clipperton Zone. Manganese nodules mining value chain[edit] Within the value chain concept of manganese nodules mining, seven main stages from prospecting to sales can be identified: Prospecting and application 3. Resource assessment, evaluation and mine planning Value is added in relation to resource classification “ Pilot mining test “ Intermediate phase “ a phase where the value of the project actually starts. For mature terrestrial mining the value can start as early as prospecting and application. Extraction, lifting and surface operations 5. Offshore and onshore logistics, transport operations 6. Metallurgical processing stage 7. Distribution and sales Value is added basing on product processing The exact components and stages can be arranged individually for the particular deep-sea mining projects of various contractors. The current focus of deep sea mining projects is aimed at exploration where phases of mining, extraction, lifting and surface operation techniques are now in planning or are tested on a smaller scale. As presented in the list the main steps of manganese nodules project value chain can be differentiated using the criteria of the type of activities where the value is actually added. Whereas within prospecting, exploration and resource assessment phases the value is added to intangible assets, for the extraction, processing and distribution phases the value increases with relation to product processing. Exploration phase

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involves such operations as locating, sea bottom scanning and sampling using technologies such as echo-sounders, side scan sonars, deep-towed photography, ROVs, AUVs. The resource valuation incorporates the examination of data in the context of potential mining feasibility. A reliable mineral resources classification is a necessary condition for economic feasibility assessment. At first a sample of nodules is taken and it is processed in ship laboratories according to the specified technology in order to determine such quantities as nodules abundance and chemical content of the deposit. The spatial distribution of nodule ore abundance and metal content is processed in GIS computer systems. Eventually statistical analysis provides for the estimation of nodule tonnage and metals in the deposit, which are the subject of the report on mineral resources classification. Value chain based on product processing involves such operations as actual mining or extraction, vertical transport, storing, offloading, transport, metallurgical processing for final products. Unlike the exploration phase, the value increases after each operation on processed material eventually delivered to the metal market. This phase is also the subject of a taxation procedure. Logistics involves technologies analogous to those applied in land mines. This is also the case for the metallurgical processing, although rich and polymetallic mineral composition which distinguishes marine minerals from its land analogs requires special treatment of the deposit. Environmental monitoring and impact assessment analysis relate to the temporal and spatial discharges of the mining system if they occur, sediment plumes, disturbance to the benthic environment and the analysis of the regions affected by seafloor machines. This involves an examination of disturbances near the seafloor, as well as disturbances near the surface. Observations include baseline comparisons for the sake of quantitative impact assessments. After a certain reporting period feedback information is provided to improve the sustainability of the mining process. The first legislative achievement of this intergovernmental organization was the adoption of regulations for prospecting and exploration for polymetallic nodules, with special provisions to protect the marine environment from any adverse effects. The Authority followed this up by signing year contracts with seven private and public entities, giving them exclusive rights to explore for nodules in specified tracts of the seabed, each 75, square kilometers in size. The United States, whose companies were among the key actors in the earlier period of exploration, remains outside this compact as a non-party to the Law of the Sea Convention. To administer the mineral resources of the seabed in the Area; To enact rules, regulations and procedures relating to these resources; To promote and encourage marine scientific research and development in the Area; To protect and conserve the natural resources of the Area and prevent significant damage to the environment. The Mining Code includes exploration and draft exploitation regulations, an Environmental Management Plan for the Clarion Clipperton Zone, and recommendations for the guidance of Contractors in terms of reporting, environmental impact assessment, expenditure reporting and training for scientists and engineers from developing nations. In due course an intergovernmental conference would review and debate the recommendations of the PrepCom. Environmental issues and sensitivities[edit] Any future mining of nodules in The Area needs to be authorised by the International Seabed Authority and would need to quantify impact in advance via an Environmental impact statement and associated Environmental Management Plan. These assessments, monitoring plans and guidance controls would likely work at the scale of proposed operations. The International Seabed Authority already has an Environmental Management Plan that considers the entire Clarion Clipperton Zone and that includes reference areas that are not available for mining termed Areas of Particular Environmental Interest. Nodule regrowth takes decades to millions of years and that would make such mining an unsustainable and nonrenewable practice. Any prediction about the effects of mining is extremely uncertain. Thus, nodule mining could cause habitat alteration, direct mortality of benthic creatures, or suspension of sediment, which can smother filter feeders.

Chapter 4 : Manganese nodule - Wikipedia

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Advanced Research Workshop on Marine Minerals: Resource Assessment Strategies, Gregynog, Wales, June , J.