

A Revised Oil Resource Evaluation Incorporating Improved Recovery and Variable Dependencies, the Beaufort-Mackenzie Basin

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Abstract

Recent studies of field growth worldwide indicate that, over the last two decades, oil reserve addition from the existing fields has added reserves similar to the contribution from new discoveries. In the past, much field growth accompanied field development and delineation. With improved geophysical tools, a large portion of the reserve growth now comes from improved recovery rather than growth of the initial in-place volume. Thus future reserve growth should be included in the estimated ultimate resource (EUR) in a resource assessment. On the other hand, the volumetric calculation of resource potential involves different levels of variable dependencies from geological risk evaluation, volumetric calculation, to resource integration at a basin or higher scales. The variable correlations are so common among the geological variables that ignoring the interdependencies may lead to a biased resource estimation and result in an under-estimated uncertainty range. However, obtaining sufficient data to define the correlation is often a challenge, particularly in a frontier region. Other difficulties of implementing the variable dependencies include the formulation of the variable correlation when the volumetric variables do not follow a multi-normal or lognormal distribution. Recent methodology development in financial risk modeling indicates that the use of copulas allows more flexibility for incorporating variable dependency using analogies and that it can easily handle non-standard normal or lognormal distribution, providing a natural way to study and measure the dependency between random variables. This paper illustrates the copula use for implementing variable dependency in the oil resource assessment of the established plays in BMB. The field reserve growth from improved recovery is handled as a variable correlation problem based on world-wide statistics of the positive correlation between in-place volume and ultimate recovery factor. Comparisons of oil resource estimates from scenarios of positive correlation and independence in the BMB suggest that when positive correlations among the variables are considered in the assessment, the mean value of basin oil EUR is almost about 1.5 times that of the EUR estimated assuming complete independence. As well the uncertainty range of the EUR is increased greatly.