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Applied Geoscience for Reserves Evaluation

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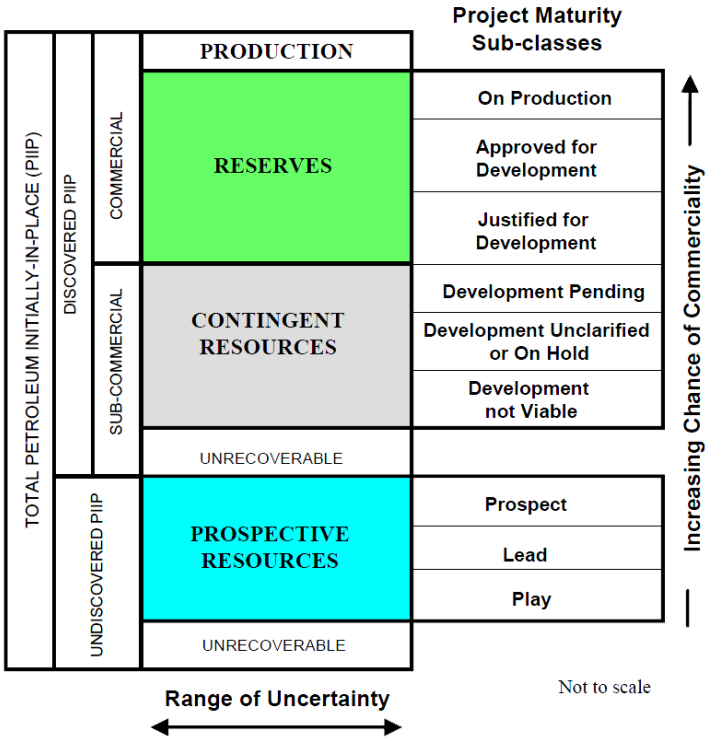
The modern Western reserve certification classifications (e.g. SPE-PRMS) are project based systems, where a project “represents the link between the petroleum accumulation and the decision-making process, including budget allocation or government approval" [1]. The two-axis SPE-PRMS system is illustrated in the figure below.

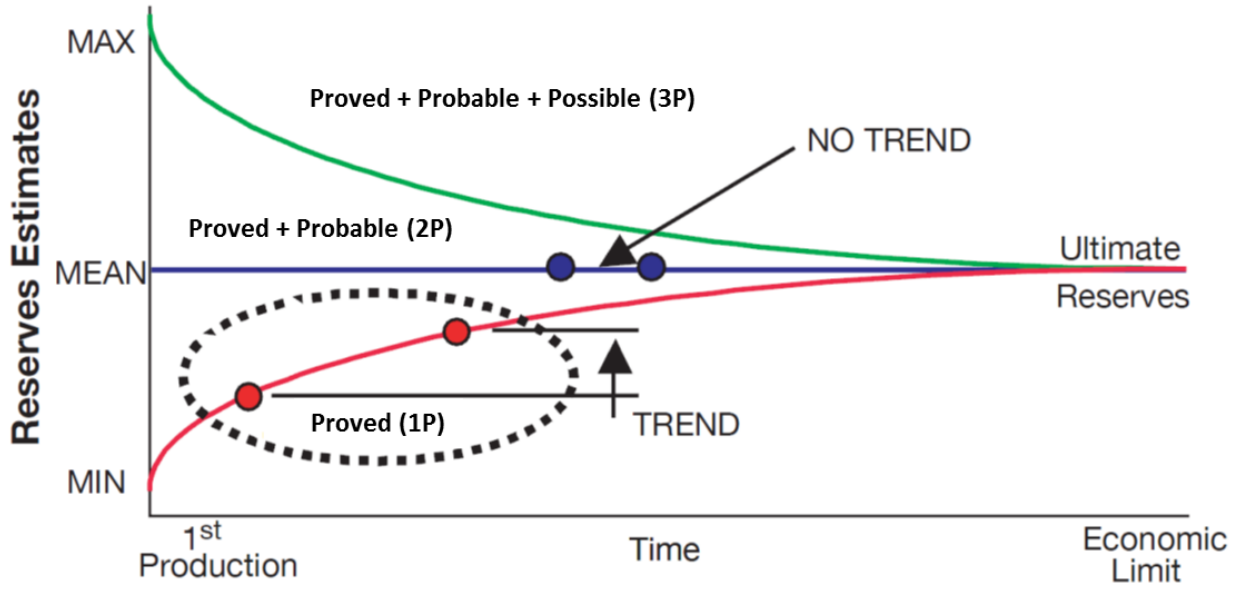


Guidelines for Application of the Petroleum Resources Management System, November 2011

It is based on the distinction between (1) the chance of commerciality of the project; and (2) the range of uncertainty in the petroleum quantities that are forecast to be produced and sold in the future from that development project.

The “range of uncertainty” reflects a range of estimated potentially recoverable volumes from an accumulation for a defined project and is being continuously reduced in magnitude with project maturation.

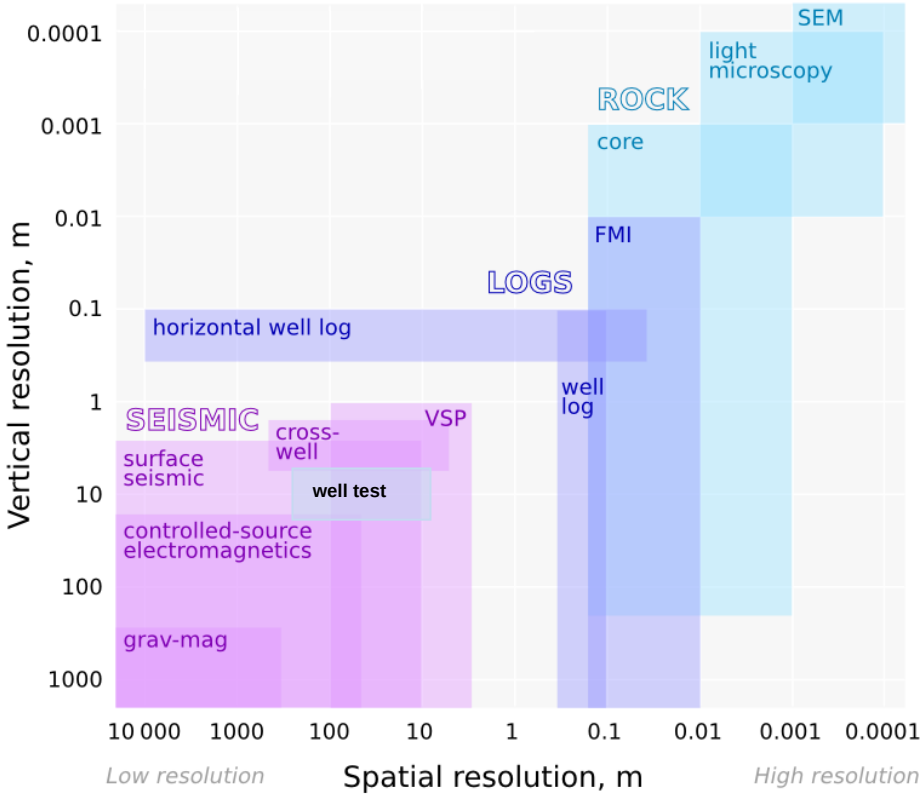
The critical point in understanding the reserve classification is that the designation of estimated volumes as a certain category, i.e. reserves vs. resources, is based on an assessment of the status of an identified project. At the same time, the sub-division of reserves into proved (1P), proved+probable (2P), and proved + probable + possible (3P) (and similarly for resources) is based on considerations of uncertainty in the ultimate expected recovery from that specific project. With time the reserves tend to converge to the 2P estimate as illustrated in the figure below, as more data is collected and the range of uncertainty diminishes.



JCPT, February 2005, Volume 44, No. 2

In the early stages of a field’s development, volumetric methods and field analogues often dominate amongst the reserve evaluation techniques. Conversely, at the later stages of a field’s development sufficient well production and performance history allow employing decline analysis. Material balance and field simulation complemented with geoscience can be used in between.

Vertical and horizontal resolution of engineering and geoscientific methods and techniques vary as shown in the figure below. Integration of the data allows more confident interpolation between wells because different methods complement each other and fill resolution gaps. For example the detailed vertical and poor lateral resolution of well data can be complimented by the much more dewtailed lateral but poorer vertical resolution of seismic data.



modified after Matt Hall, 2010 agilegeoscience.com

Application of geophysics, mainly seismic, to reserve estimation can generally be grouped into those which map the trap geometry, those which characterize reservoir and fluid properties and those which identify changes in the distribution of fluids and pressure changes resulting from production [2]. Seismic amplitude anomalies can also be used in certain cases to support reservoir and fluid continuity in a faulted reservoir or below the lowest known hydrocarbons as observed in wells.

In case of unconventional plays there may be no geometric traps to map. In such cases mapping focuses on determining gross rock volume, stratigraphic sub-divisions and faults which may be source of unwelcome water or control better reservoir deliverability.

Other methods such as geostatistics attempt to address the uncertainty distributions in the input parameters and the correlations between them. Geochemistry can be used not only at a regional exploration project scale, but also at a field scale to allocate production from commingled reservoirs.

Reserve evaluators and auditors have certain guidance on how geoscience and particularly seismic should be used. The Guidelines for Application of the Petroleum Resources Management System document was issued in November 2011 to accompany and support the SPE-PRMS. It updates the 2001 document Guidelines for the Evaluation of Petroleum Reserves and Resources and one of the ten chapters addresses seismic applications. Early in 2014 the Society of Petroleum Evaluation Engineers (Calgary Chapter) has agreed to submit Chief Geophysical Forum Reserves document on Geophysical Applications – Using Geophysics for Reserves and Resources Classification and Assessment prepared by the Canadian Society of Exploration Geophysicists in 2011 for review by its membership. Pending this review, the document will be distributed to holders of COGEH Volume II as an Appendix. The Securities

Exchange Commission has also allowed in 2009 the use of “reliable technology” including combination of seismic data and interpretation in reserve estimation “for establishing levels of lowest known hydrocarbons and highest known oil through reliable technology other than well penetrations” [3] for disclosure purposes.

The paper provides an overview of several cases of integrated team approach to reserves estimation.

References

1. Guidelines for Application of the Petroleum Resources Management System, November 2011

2. CGF Reserves document on Geophysical Applications – Using Geophysics for Reserves and Resources Classification and Assessment - FINAL DRAFT December 2011

3. Securities and Exchange Commission 17 CFR Parts 210, 211 et al. Modernization of Oil and Gas Reporting; Final Rule January 14 2009