



COMMITTEE FOR MINERAL RESERVES INTERNATIONAL REPORTING STANDARDS

## **Mineralisation beyond Inferred Resources**

### **- a CRIRSCO position paper**

#### **Position statement**

The principle objective of the Committee for Mineral Reserves International Reporting Standards (CRIRSCO) is to promote best practice public reporting of Exploration Results, Mineral Resources and Mineral Reserves. As a strategic partner of the International Council on Mining and Metals (ICMM), CRIRSCO endorses the aim of that organisation to promote transparency and clarity in all reporting carried out by the solid minerals industry.

The CRIRSCO International reporting Template (the Template) includes a number of Mineral Reserve and Mineral Resource categories, based on the extent to which these have been defined by geological, other technical and economic studies. The main stakeholders in public resource and reserve reporting are investors and potential investors in mineral companies, including financial institutions.

CRIRSCO recognises that situations exist where reporting of potential mineral assets beyond the categories defined by the Template may be required and that different stakeholders, such as governments, may require reports on these additional categories.

CRIRSCO has engaged and continues to work with organisations developing classifications of material 'beyond Inferred' with the aim of both assisting in such developments and also ensuring that the resulting classification schemes are consistent with the Template.

CRIRSCO will continue to monitor developments in other classification systems but at this stage does not propose to modify the Template to accommodate mineralisation beyond Inferred Resources.

#### **Summary**

CRIRSCO reporting standards are contained in the CRIRSCO International Reporting Template, published in July 2006, which defines Exploration Results, Mineral Resources, including sub-categories of Measured, Indicated and Inferred Resources, and Mineral Reserves, including sub-categories of Proved and Probable Reserves. The definitions contained in the CRIRSCO Template have been adopted by CRIRSCO members although due to specific local requirements minor differences may exist among member reporting Codes and Standards<sup>1</sup>. These differences are not considered to be material.

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<sup>1</sup> The term 'Code' is generally used to describe reporting systems where there are formal and legally binding uses defined by regulators. The term 'Standard' is used to describe systems which may be very similar in content to the Codes but which are not the subject of such legal agreements. Henceforward in this paper the generic term standard is used to denote both Codes and Standards.





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Public reporting is targeted at investors and potential investors in mineral exploration and mining companies. Such stakeholders rely on informed statements relating to Exploration Results, Mineral Resources or Mineral Reserves prepared by Competent Persons as defined in the Template.

CRIRSCO acknowledges that mineralisation may exist beyond those categories contained in the Template and also acknowledges that it is common practice amongst mineral companies to maintain registers or inventories of such material for their own strategic planning purposes. Such purposes include, for example, the prioritisation of exploration targets for future work and maintaining records of mineralised material that currently fails to meet requirements for public reporting but may do so in future (for example if economic conditions change).

This paper is intended to expand on CRIRSCO's views on 'Mineralisation beyond Inferred Resources' and to explain the relationship between the CRIRSCO-aligned reporting standards and other classification systems that categorise such material.

### Background

In July 2006, CRIRSCO published the International Reporting Template for the public reporting of Exploration Results, Mineral Resources and Mineral Reserves ('the Template')<sup>2</sup> which represents a synthesis of the minerals reporting standards of CRIRSCO members. CRIRSCO members currently comprise the National Reporting Organisations (NROs) of Australia, Canada, Chile, South Africa, the UK and Western Europe and USA. The Template and individual member standards are for public reporting for the benefit of investors or potential investors in mining and exploration companies. Definitions of Mineral (or Ore) Reserves and Mineral Resources are very closely aligned amongst the various NRO reporting standards and are well known and understood in the stakeholder groups which they serve, including not only investors but financial institutions and the media.

CRIRSCO engages with other organisations that categorise or may consider categorising, mineralisation that is not defined in the Template to ensure that definitions are not contradictory and that such extended systems are complementary to the Template. Such organisations include the United Nations Economic Commission for Europe (UNECE), the Society of Petroleum Engineers (SPE), the International Accounting Standards Board (IASB) and various international agencies and governments. Such categories of mineralisation are generally not of interest to investors and are not reported publicly but may be required to be reported to other institutions such as governments, or may be of use internally by companies developing exploration strategies, prioritising development options or purchase price accounting for exploration prospects. The Template caters to some extent for this by defining Exploration Results, which are points of information, usually derived from drilling and sampling, which may be of interest to investors but which are insufficient to estimate Mineral Resources.

In some NRO jurisdictions (currently not in the Template) the term exploration targets is used as a sub-set of Exploration Results. Exploration targets allow minerals companies to discuss minerals potential that may arise from future exploration. Reporting of such targets, which are conceptual in

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<sup>2</sup> Available at <http://www.crirSCO.com/template.asp>





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nature, is strictly constrained so that report users will not confuse exploration targets and Mineral Resources.

CRIRSCO's engagement with other organisations has helped to develop an understanding of mineral definitions across different industry sectors and for different users. This work has included discussions of the categories of mineralisation that exist in other systems that are not primarily intended for public reporting and which are not part of the Template.

### **The CRIRSCO Template and other systems**

The Template was published to provide countries that did not have a minerals classification and reporting standards or that wanted to modify their own standard to become internationally compatible, with a guide to reporting of Exploration Results, Mineral Resources and Mineral Reserves. Changes to the Template are made with members' agreement and in turn, changes to individual member standards are openly discussed in CRIRSCO in order to preserve international compatibility. The Template thus represents current international best practice in minerals reporting.

The Template contains definitions for Exploration Results, Mineral Resources (including Measured, Indicated and Inferred Resources) and Mineral Reserves (including Proved and Probable Reserves).

The general relationship between these defined terms is illustrated in Figure 1 (a) and will be familiar to users of the Template. The highest level of confidence is represented by Proved Reserves and the lowest by Exploration Results.

For the purposes of this paper, the conventional representation has been re-oriented in Figure 1 (b) to facilitate comparison with two other systems; the Petroleum Resource Management System (PRMS)<sup>3</sup> sponsored by the Society of Petroleum Engineers and others, and the United Nations Framework Classification (UNFC 2009)<sup>4</sup> which is a product of the United Nations Economic Commission for Europe, both of which systems contain categories of mineralisation not found in the CRIRSCO Template. In a general sense, confidence decreases from top to bottom in this illustration.

Further details of the mapping exercise conducted between the CRIRSCO system and the PRMS on behalf of the International Accounting Standards Board in 2007 can be found at

<http://www.ifrs.org/NR/rdonlyres/0E012C2E-EE3E-4E8E-8321-85286B16FEA/0/Extract0803b10bobs.pdf>

A report entitled Mapping of the United Nations Framework Classification for Fossil Energy and Mineral Resources, which compares the CRIRSCO and PRMS systems to the UNFC, can be obtained from [http://www.unece.org/energy/welcome/pub/ense.html#map\\_unfcu](http://www.unece.org/energy/welcome/pub/ense.html#map_unfcu)

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<sup>3</sup> Available at <http://www.spe.org/industry/reserves/prms.php>

<sup>4</sup> Available at <http://www.unece.org/energy/se/reserves.html>

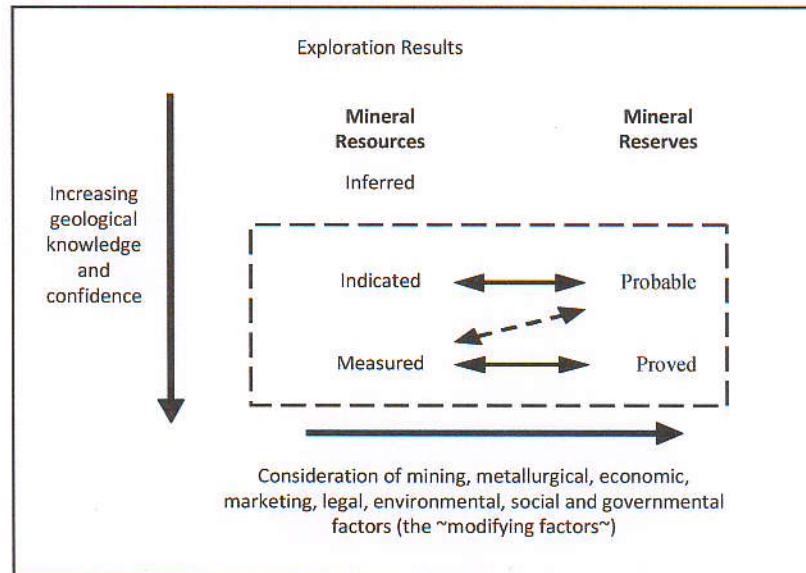
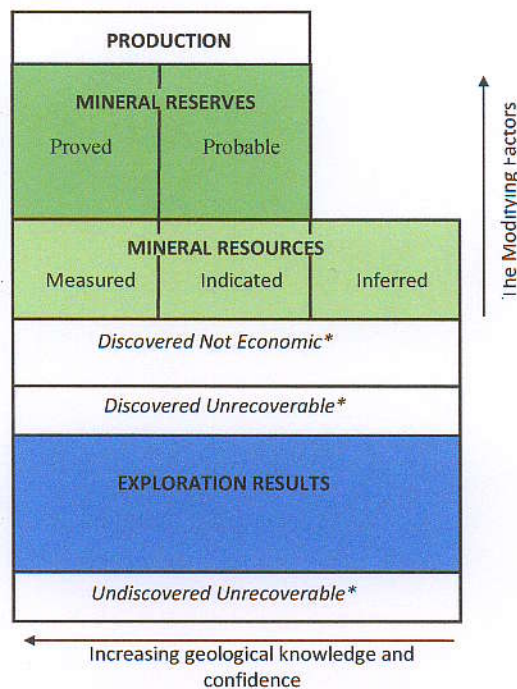


Figure 1 (a) General relationship between Exploration Results, Mineral Resources and Mineral Reserves as represented in the CRIRSCO Template



\*Not part of the Template but may be used for internal project management

Figure 1 (b) re-oriented figure showing the CRIRSCO categories (shaded) and additional categories in other systems

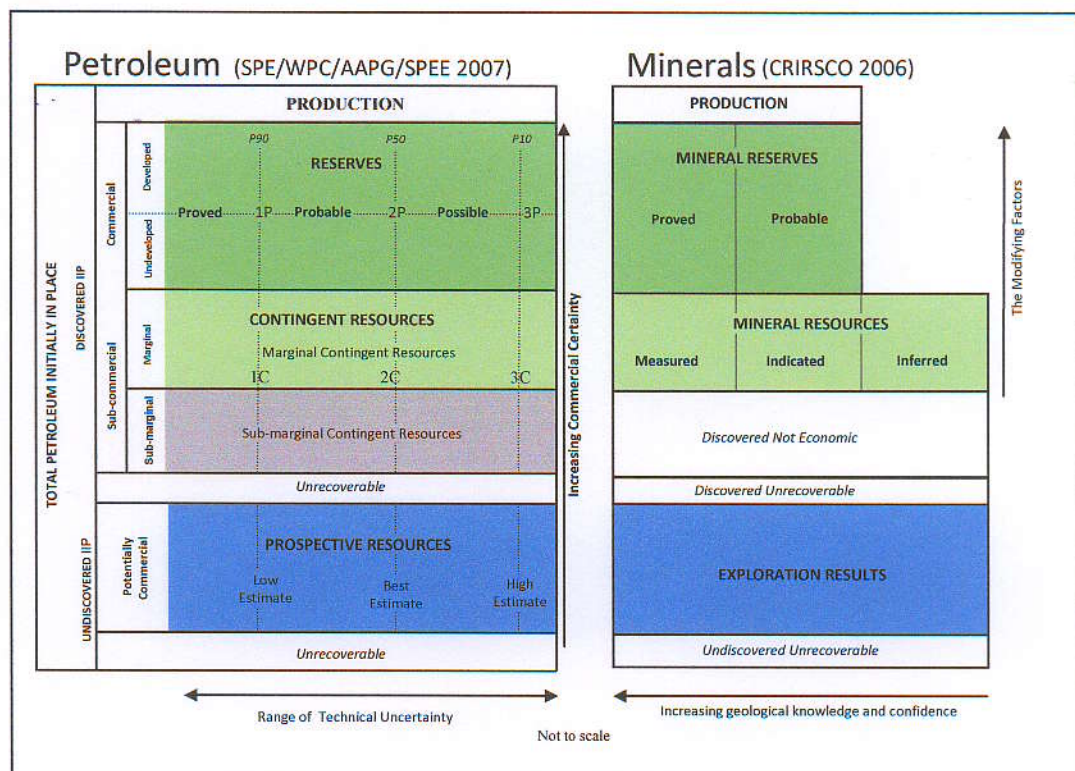


## Expanded classification systems

The most obvious differences between the two versions of the classification scheme in Figure 1 are the additional 'boxes' labelled Production, Discovered Not Economic, Discovered Unrecoverable and Undiscovered<sup>5</sup>. Essentially, the conventional CRIRSCO system includes only classes that are publicly reported, while the expanded version includes material that may be part of non-public reports to other agencies, such as governments, or simply of use to companies for internal planning purposes.

Taken as a whole, the system in Figure 1 (b) is intended to include all mineralisation that has been mined, discovered or is yet to be discovered within a given area, be this a single mine, a mineralised province or a global aggregation of many mineralised areas.

Figure 2 illustrates the alignment between the Template and the PRMS developed jointly by the SPE and CRIRSCO.



**Figure 2 Comparison of the Petroleum Resource Management System (PRMS) and the CRIRSCO Template**

<sup>5</sup> Terms such as 'Discovered Not Economic' are not officially used by CRIRSCO but were incorporated as a means of simplifying comparison with PRMS.





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In Petroleum, the whole of the box is termed Total Petroleum Initially in Place. Ignoring production (which is generally reported separately to resources and reserves by minerals companies), those boxes shaded on the right have direct or near direct equivalents in the PRMS.

A high level comparison of UNFC (2009) and the Template, developed as a result of a joint exercise to map the two systems, is shown in Figure 3, with text modified to highlight the Mineral Reserves, Mineral Resources and Exploration Results areas represented in the Template. As examples, in the UNFC's numerical codification system a Proved Reserve would be 1,1,1, an Inferred Resource 2,2,3 and Exploration Results 3,3,4.<sup>6 7</sup>

Total commodity initially in place	Production	Sales Production			
		Non-sales Production			
		Class	Categories		
			E	F	G
	Future recovery by commercial development projects of mining operations	Mineral Reserves	1	1	1,2,3
	Potential future recovery by contingent development projects or mining operations	Mineral Resources	2	2	1,2,3
		Discovered Not Economic	3	2	1,2,3
	Discovered Unrecoverable		3	4	1,2,3
	Potential future recovery by successful exploration activities	Exploration Results	3	3	4
	Undiscovered Unrecoverable		3	4	4

**Figure 3 A high level comparison between UNFC (2009) and the CRIRSCO Template**

### The boundaries of CRIRSCO Mineral Resources

The CRIRSCO Template and NRO reporting standards require that Mineral Resources should have 'reasonable prospects for eventual economic extraction'. While the precise meaning of words such as 'reasonable', 'eventual' and 'economic' can be and are continuously debated, the phrase is generally taken to mean that given a set of reasonable assumptions on inputs such as prices, costs,

<sup>6</sup> Terminology has been changed from UNFC (2009) to align with that used Figure 2. For example 'Discovered Unrecoverable' is described in UNFC (2009) as 'Additional quantities in place associated with known deposits'.

<sup>7</sup> As defined in UNFC (2009), E = Social and economic viability; F = Field project status and feasibility; G = Geological knowledge. Numerical values range 1-4 with 1 being the highest confidence.





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production rates and mineral recoveries, and a positive economic evaluation, it can be assumed that an eventual mining operation is realistically both technically and economically viable.

Guidance provided in the Template notes that a decision on whether the test of reasonable prospects has been met requires judgment by a Competent Person or Persons and goes on to say: 'a Mineral Resource is not an inventory of mineralisation drilled or sampled, regardless of cut-off grade, likely mining dimensions, location or continuity. It is a realistic inventory of mineralisation which, under assumed and justifiable technical and economic conditions, might, in whole or in part, become economically extractable'.

This clearly sets a 'lower' boundary to Mineral Resources which must meet the test of 'reasonable prospects for eventual economic extraction', that is to say, all classes of Mineral Resource are implicitly economic and a viable target for future development, but without guarantees that such development will eventuate.

The following sections discuss each of the boxes 'beyond Inferred' and how CRIRSCO interprets these. Exploration Results will be included as a special case where, despite the fact that they form part of the Template, they are treated differently to their equivalents in PRMS or UNFC.

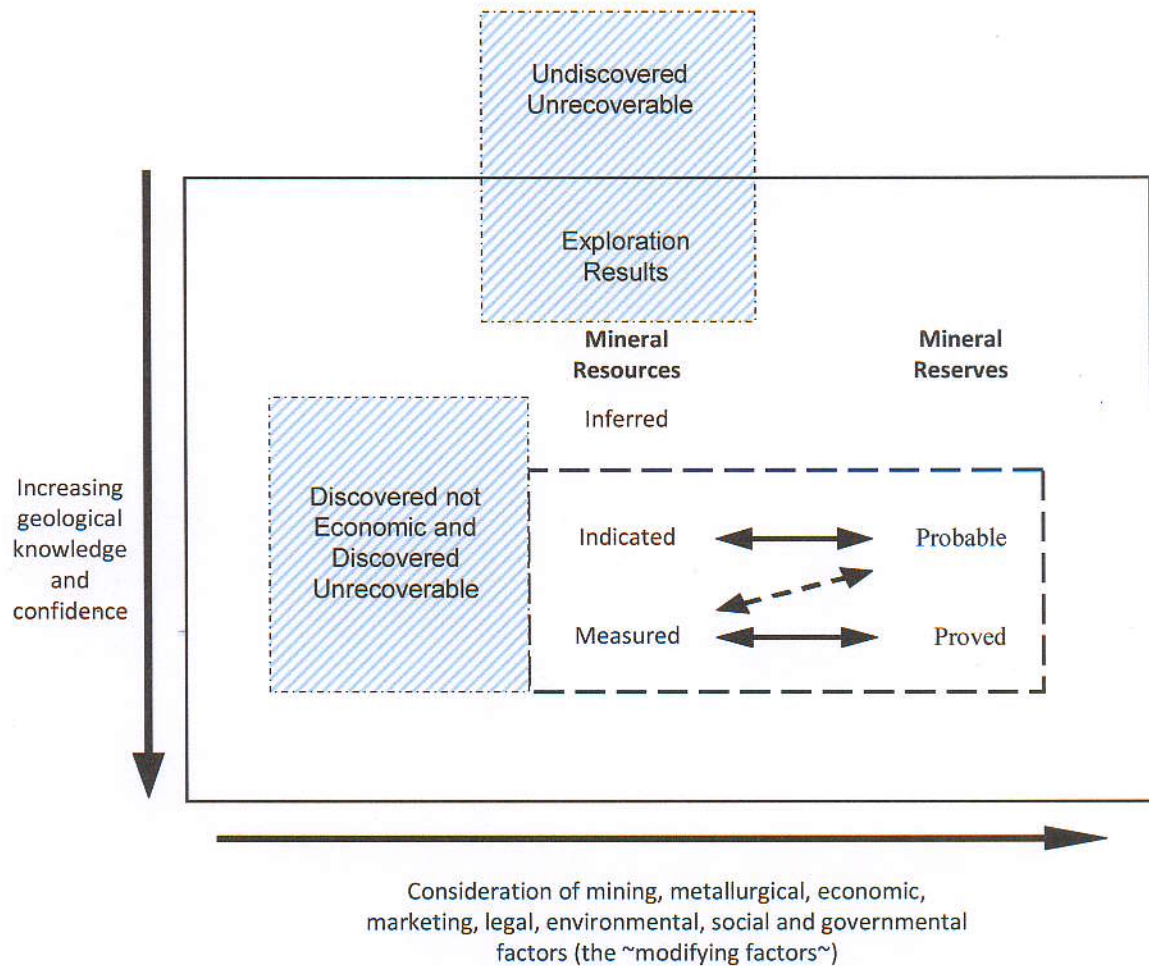
None of these categories currently meet the test of reasonable prospects for eventual economic extraction for any of a number of reasons. However, the use of the word currently is deliberate as it is to be expected that this 'mineralised inventory'<sup>8</sup> would be dynamic over time and that material would move through the categories, or be removed altogether, depending on the results of continued exploration and technical studies.

Figure 4 illustrates the relationship between categories of mineralisation that are 'beyond Inferred' and the standard CRIRSCO categories shown in Figure 1.

Categories that occur 'upwards' from Inferred Resources (including Exploration Results) have a very low level of confidence due to the lack of geological information. Categories that are to the left of Mineral Resources are located thus on the basis of uncertainties or negative impacts arising from the modifying factors. In simple terms they are not economic and not currently of interest for mining.

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<sup>8</sup> The term mineralised inventory is used here to describe material that does not currently qualify as a resource; some companies internally use the term 'potential resources' with essentially the same meaning.



**Figure 4 Categories of mineralisation 'beyond Inferred'**

### Discovered Not Economic

This term was coined to provide a direct equivalent to the class of Sub-marginal Contingent<sup>9</sup> Resources in the PRMS.

In terms of geological confidence, there is no difference between categories under Discovered Not Economic and Mineral Resources. The extent to which geological and grade continuity is demonstrated means that Discovered Not Economic categories can be geologically the equivalent of Measured, Indicated or Inferred, as demonstrated in the UNFC 2009 codification in Figure 3 where they occupy 'boxes' 3.2.1, 3.2.2 and 3.2.3.

<sup>9</sup> The term 'contingent' used in the definition of petroleum resources refers to a number of factors, or contingencies, that must be met before the resources can convert to reserves. Contingencies are directly equivalent to the 'modifying factors' of CRIRSCO.





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The extent to which such mineralisation has been studied to determine its technical and economic viability is also likely to be the same as for Mineral Resources. The key difference is that, at the time of estimation, Discovered Not Economic fails the test of reasonable prospects for eventual economic extraction and can therefore not be publicly reported.

Typical reasons for failing the test can include too low a commodity price, or a recovery process that either fails to deliver adequate quantities or quality of product or requires the application of untested or unproven technologies.

As conditions can change with time, companies commonly maintain an inventory of mineralisation where there is a belief that, for example, prices will improve in future or new technologies will be developed to economically recover the minerals, leading to reclassification as a Mineral Resource and potentially a Mineral Reserve.

In larger mineral companies that may adopt a long term view of the industry, often looking several decades ahead, it is quite reasonable to suppose that material that could potentially become resources and reserves in the future should be retained 'on file' and incorporated, with appropriate caveats, in long term strategic planning.

For junior companies, often with only a single significant project, the decision on how to handle discovered not economic mineralisation is more difficult. Retaining property and continuing to explore comes at a cost that must be met by the company owners, investors or financiers. In most cases, the decision will be based on a continuous assessment of whether or not the deposit has 'reasonable prospects for eventual economic extraction'.

The presence of mineralisation, even if currently uneconomic, can provide a junior company with leverage in discussions with potential investors and there is no reason why the results of exploration can not be discussed for this purpose (see Exploration Results below). However, when reporting under CRIRSCO-aligned reporting standards, it must always be made clear that the material does not qualify as a Mineral Resource.

### **Discovered Unrecoverable**

Most mining and exploration practitioners will be familiar with the concept that mineralisation can be discovered but that it may be unrecoverable for a number of reasons. Examples where recovery may never be possible include locations where mining is not allowed, such as in sites of cultural or environmental significance, such as national parks, or where the material is needed to protect access to the greater part of a Mineral Reserve, such as in permanent shaft pillars.

There are many other examples where the mineralisation may be currently unrecoverable but it is not out of the question that recovery might be possible in future, for example where alternative accesses can be constructed, infrastructure moved or new technologies become available, for example in deep sea or very high temperature environments.





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Discovered Unrecoverable mineralisation is contained in the 'boxes' 3.4.1, 3.4.2 and 3.4.3 in the UNFC 2009 classification.

## Exploration Results

Exploration Results represent a special case where, although there are broad similarities with the equivalent Prospective Resources in the PRMS there are a number of concepts that differ between petroleum and minerals.

All petroleum resources, whether discovered or not and recoverable or not, are attributed an estimated recoverable volume. This may be done statistically based on fairly limited data compared to minerals where confidence in a volume estimate commonly relies on far more drill holes and samples. In effect, Exploration Results represent an intermediate point on the development curve from an initially identified exploration target to a formal discovery when resources can be estimated and published. They typically include points of data, such as outcrop sampling or drill hole intercepts, without any attempt to link or interpolate these to create volumes.

Exploration Results may be publicly reported but not as estimates of tonnes and grade due to the inadequate available data. Any estimates of potential tonnage and grade will be speculative and may be based on analogous geological settings<sup>10</sup>. These may be useful for internal planning and prioritisation of exploration effort but are not relevant to the Template which is for public release of information.

The nearest equivalent to Exploration Results in UNFC 2009, although expressed in tonnage and grade terms, is 3.3.4.

## Undiscovered Unrecoverable

While the concept of a body of mineralisation that is both undiscovered and unrecoverable might be alien to practitioners in the minerals industry, it is easier to understand in the context of the probabilistic approach taken in the petroleum sector. At any point in time there will be a statistical probability that extensions may exist to known resources or that regions known to host oil or gas will yield new discoveries.

In the minerals industry it is possible to estimate the probability of making a resource discovery as a guide to developing exploration programmes, and there is likelihood that a proportion of any such discoveries would be unrecoverable. However, recoverability is not likely to be a significant consideration during early stage exploration.

While CRIRSCO recognises such statistical possibilities, the category is clearly of little interest to investors and would most likely cause considerable confusion if publicly reported. In UNFC 2009, Undiscovered Unrecoverable mineralisation is allocated to 'box' 3.4.4.

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<sup>10</sup> Some CRIRSCO member Codes and Standards include reference to 'exploration targets' where quantities and grades may be mentioned but only under strictly controlled conditions and with a clear explanation that these do not constitute Mineral Resources.





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### **Uses for a Mineralised Inventory**

Most companies that report Exploration Results, Mineral Resources or Mineral Reserves are also likely to maintain some form of additional mineralised inventory, even though this will not be publicly reported. Most commonly such an inventory will simply be a complete record of mineralisation beyond what is publicly reported contained within property over which the company has exploration and/or development rights.

In some countries it may be necessary to submit information on a mineralised inventory to government agencies for the purposes of long term strategic mineral planning, but in most cases the inventory will be used by the company for its own purposes. Typical examples would be where mineralisation has been discovered and quantities estimated but studies have shown it to be below a break-even cut off grade or minimum mining thickness and therefore technically or economically unviable. Where there is a possibility that this situation could change in future; with an increase in commodity prices for example, it would be retained 'on file' for further consideration at an appropriate time.

There are no formal rules for what is recorded in a Mineralised Inventory. Early stage conceptual estimates of potential mineralisation may co-exist with areas where mineralisation is known to exist as shown by detailed drilling. Similarly, there is no formal classification of types of mineralisation within an inventory. As no public reporting is involved, these are generally left to the discretion and business needs of individual companies, although as noted above, there may be instances where governments and international agencies could be interested in certain categories of mineralised inventory. An example of this is 'Inventory Coal' a term used in Australia to define all in situ coal before mining and economic constraints have been applied.

Higher level strategic studies by governments or international agencies may attempt to consolidate all reserve, resource and additional inventory mineralisation into a form where an assessment of future mineral potential for a country or region can be made. In CRIRSCO's view a simple aggregation of numbers in this way can be misleading in that it adds together material of different confidence level, for example resources and reserves, or attempts to quantify mineralisation at a stage of development that is too early for such estimates to be meaningful. For that reason, reporting using the Template requires that all mineral categories are stated separately and, if aggregated, then this is done only on a like for like basis, for example reserves may be added to reserves, but not to resources.

CRIRSCO encourages discussion on this topic. Comments should be addressed to the Chairman whose details are available at [www.crirSCO.com](http://www.crirSCO.com).