



**中国国家标准《固体矿产资源/储量分类》  
(GB/T 17766-1999) 与《联合国资源  
分类框架》(UNFC) 对接文件**

**Bridging Document  
between  
National Standard of the People's Republic of China  
“Classification for Resources/Reserves of Solid Fuels and  
Mineral Commodities (GB/T 17766-1999)” and  
“United Nations Framework Classification for  
Resources (UNFC)”**

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## 前言 FOREWORD

此对接文件是中华人民共和国自然资源部与联合国欧洲经济委员会友好合作的成果，由国土资源部矿产资源储量评审中心和联合国资源分类专家组的技术顾问组联合起草，自 2015 年 4 月，双方签署编制对接文件协议开始至 2018 年 7 月，历时三年多完成。

This Bridging Document is the result of the friendly cooperation between the Ministry of Natural Resources of People's Republic of China(MNR) and the United Nations Economic Commission for Europe(UNECE). This Bridging Document was developed by the Mineral Resources and Reserves Evaluation Center of the Ministry of Land and Resources in cooperation with the Technical Advisory Group of the Expert Group on Resource Classification. The preparation process lasted more than three years from the beginning when the two sides signed an agreement on the preparation of the Bridging Document in April 2015, until July 2018.



# 中国国家标准《固体矿产资源/储量分类》（GB/T 17766-1999） 与《联合国资源分类框架》（UNFC）对接文件

国土资源部矿产资源储量评审中心与联合国资源分类专家组技术咨询  
组联合编制<sup>1</sup>

## 综述

本文件为中华人民共和国国家标准《固体矿产资源/储量分类》(GB/T 17766-1999)和《联合国资源分类框架》(UNFC)的对接文件。对接文件的作用是解释 UNFC 与另一个经联合国资源分类专家组认可的“对应分类体系”之间的关系。对接文件包含如何应用 UNFC 数字编码对“对应分类体系”的评价结果进行分类的说明与指南。本对接文件对比了 GB/T 17766-1999 和 UNFC 资源/储量的类别、级别。GB/T 17766-1999 是 1999 年颁布实施的中国国家标准，适用于固体矿产资源勘查与开发各阶段的设计编制、工作部署、矿产资源储量估算和报告编写等。本对接文件不影响 GB/T 17766-1999 的独立应用，GB/T 17766-1999 的应用也不影响 UNFC 的任何内容。当本对接文件的中文版与其他语言版本存在任何歧义时，以中文版为准。

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<sup>1</sup> 本对接文件由国土资源部矿产资源储量评审中心与资源分类专家组技术咨询组联合研制。本对接文件经 2017 年 4 月 24 日至 28 日召开的第 8 次专家组大会审查之后，于 2018 年 2 月 15 日至 4 月 15 日进行了公示。本对接文件的研制遵循 2014 年 4 月专家组第五次会议商定的文件批准程序。本对接文件经可持续能源委员会第 27 次会议审定。

## I. 引言

1. 《固体矿产资源/储量分类》(GB/T 17766-1999) (以下简称“GB/T 17766-1999”) 与《联合国资源分类框架》(以下简称“UNFC”) 对接文件 (简称“对接文件”), 说明了 GB/T 17766-1999 与 UNFC 的对应关系。
2. GB/T 17766-1999 独立于 UNFC。对接文件不影响 GB/T 17766-1999 的独立应用。
3. GB/T 17766-1999 的应用亦不影响 UNFC 的所有组成部分。

## II. GB/T 17766-1999 概述

### A. GB/T 17766-1999 简要介绍

4. GB/T 17766-1999 是 1999 年颁布实施的中国国家标准, 适用于固体矿产资源勘查及开采各阶段编制设计、部署工作、估算矿产资源储量、编写报告; 也适用于固体矿产资源储量评审、登记、统计, 制定规划、计划, 制订固体矿产资源政策, 编制矿产勘查规范、规定、指南; 也可作为矿业权转让、矿产勘查开采筹资融资等活动中评价、估算矿产资源储量的依据。
5. GB/T 17766-1999 对查明矿产资源和潜在矿产资源进行分类。查明矿产资源进一步划分为三类: 资源量 (Mineral Resources)、基础储量 (Basic Reserves) 和储量 (Reserves), GB/T 17766-1999 采用三维数字编码结构, 基于经济意义 (E)、可行性评价阶段 (F) 和地质可靠程度 (G) 三轴组合, 确定矿产资源的类别。表 1 是 GB/T 17766-1999 的全部分类及其对应编码。
6. 作为中国的国家标准, GB/T 17766-1999 与各矿种勘查规范以及各种勘查技术规范、规程, 构成了一个完整的中国矿产资源储量标准体系, 保障中国矿产资源勘查开采的有序进行和工作质量。
7. 在矿产资源储量估算和管理领域, 中国有显著的特点。
8. 矿产勘查和开采过程分为三个大的阶段: 矿产勘查、矿山设计和建设、矿山生产。矿产勘查划分为四个阶段: 预查、普查、详查和勘探。
9. 工业指标的应用是 GB/T 17766-1999 另一显著特点。工业指标是在一定时期的技术经济条件下, 对矿床矿石质量和开采技术条件方面所提出的指标, 是圈定矿体、估算矿

产资源储量的依据。通常包括一般工业指标和论证制订的矿床工业指标。一般工业指标是业界在长期的矿产勘查、技术经济论证和开采活动中经验的积累和总结，通常用于矿产勘查的预查、普查阶段。论证制订的矿床的工业指标是由相关专业的技术人员综合考虑地质、采矿、选冶、综合利用、经济、环保、法律、社会和政府等众多因素后，并经规范性程序形成的技术经济评价结果。论证制订的矿床工业指标一般用于矿产勘查的详查、勘探阶段，矿山设计和建设，以及矿山开采方面。工业指标论证过程实质是预可行性和可行性研究的过程。

表 1  
GB/T 17766-1999 分类表

地质可靠程度 分类 类型 经济意义	查明矿产资源			潜在矿产资源
	探明的	控制的	推断的	预测的
经济的	可采储量 (111)			
	基础储量 (111b)			
	可采储量 (121)	可采储量 (122)		
	基础储量 (121b)	基础储量 (122b)		
边际经济的	基础储量 (2M11)			
	基础储量 (2M21)			
次边际经济的	资源量 (2S11)			
	资源量 (2S21)			
内蕴经济的	资源量 (331)	资源量 (332)	资源量 (333)	资源量 (334)?
注：表中所用编码(111—334)，第 1 位数表示经济意义：1=经济的，2M=边际经济的，2S=次边际经济的，3=内蕴经济的，?=经济意义未定的；第 2 位数表示可行性评价阶段：1=可行性研究，2=预可行性研究，3=概略研究；第 3 位数表示地质可靠程度：1=探明的，2=控制的，3=推断的，4=预测的。b=未扣除设计、采矿损失的可采储量。				

10. 中国矿产勘查工作内容不仅仅包括通过物探、化探、地质填图、槽探、钻探、孔内地球物理测量等工作获得区域地质、矿体地质的知识，还包括水文地质、工程地质、环境地质研究和评价，以及矿石的工艺矿物学、矿石加工选冶技术性能的研究，最终是为了满足矿山建设设计和矿山生产的需要。

11. GB/T 17766-1999 矿产勘查和开采阶段、可行性评价和矿产资源储量分类对应关系见表 2。



表 2

矿产勘查和开采阶段、可行性评价和矿产资源储量分类对应关系

矿产资源勘查和 开采阶段		目标	可行性评价	工业指标应用	分类情况
矿产 勘查	预查	找到矿化潜力较大的区域	非常简单的技术经济研究	一般工业指标	(334)?
	普查	发现矿床	概略研究	一般工业指标	(333)、(334)?
	详查	判断矿床（项目）是否具有工业利用价值	预可行性研究或概略研究	经过论证的矿床工业指标	如果具有工业利用价值，经概略研究，则分类为 (332)、(333) 和少量(334)?；经预可研，则分类为 (122b)、(333)。如果不具有工业利用价值，则矿产勘查工作结束，没有资源量纳入国家矿产资源储量库。
	勘探	为矿山建设可行性研究和矿山设计和开采提供依据	可行性研究、预可行性研究或概略研究	经过论证的矿床工业指标	概略研究:(331)、(332)和(333)； 预可行性研究:(121b)、(122b)、(333)、(121)和(122)； 可行性研究:(111b)、(122b)、(333)、(111)和(122)。
矿山设计建设		按时完成矿山建设	矿山设计	经过论证的矿床工业指标	(111b)、(122b)、(333)、(111)和(122)。
矿山生产		按计划获得商业产品并满足现金流的要求和质量控制要求	生产计划	经过论证的矿床工业指标	(111b)、(122b)、(333)、(111)和(122)。

### III. UNFC 概述

12. UNFC 由联合国欧洲经济委员会 (UNECE) 组织专家制定, 经 UNECE 批准出版。适用于国际能源和矿产研究、政府资源管理、企业规划产业流程和高效配置资本等。

13. UNFC 是一个基于通用原则的分类体系, 由经济和社会活力 (E)、项目状态和技术可行性 (F) 以及地质认知程度 (G) 三轴组合进行分类, 以三维数字编码表示类别。

14. 各轴划分为不同级, 如 F 轴划分为三级 F1、F2、F3, 各级又进一步划分了亚级(如 F1 又划分为 F1.1、F1.2、F1.3), 具体情况见表 3。

表 3

UNFC 分类及亚类

总商品原地量 (Total Commodity Initially in Place)	采出量 (Extracted)	销售产量（Sales Production）					
		非销售产量（Non-sales Production）					
	类 (Class)		亚类 (Sub-class)		级(Categories)		
					E	F	G
	已知矿床 (Known Deposit)	商业项目 (Commercial Projects)	正生产 (On Production)		1	1.1	1,2,3
			已批准开发 (Approved for Development)		1	1.2	1,2,3
			已论证可开发 (Justified for Development)		1	1.3	1,2,3
		潜在商业项目 (Potentially Commercial Projects)	待开发 (Development Pending)		2	2.1	1,2,3
			延迟开发 (Development On Hold)		2	2.2	1,2,3
		非商业项目 (Non-commercial Projects)	开发未明确 (Development Unclassified)		3.2	2.2	1,2,3
开发不可行 (Development Not Viable)			3.3	2.3	1,2,3		
原地不可采量 (Additional Quantities in Place)			3.3	4	1,2,3		
潜在矿床 (Potential Deposits)	预查项目 (Exploration Projects)		没有亚类定义 (No sub-classes defined)		3.2	3	4
	原地不可采量 (Additional Quantities in Place)				3.3	4	4

## IV. 轴的对应

### A. G 轴的对应

15. GB/T 17766-1999 的 G 轴为地质可靠程度，代表勘查工作成果的精度，划分为四级：探明的（1）、控制的（2）、推断的（3）和预测的（4）。

16. UNFC 的 G 轴代表地质认知程度，分四级。

17. 二者 G 轴级别划分基本上可一一对应，如表 4 的灰色区域（地质可靠程度行）。

### B. F 轴的对应

18. GB/T 17766-1999 的 F 轴是可行性评价阶段，划分为：可行性研究（1）、预可行性研究（2）和概略研究（3），无亚级。

19. UNFC 的 F 轴代表项目状态和技术可行性，划分为 F1、F2、F3 和 F4 四级，其中 F1、F2 可划分亚级。F 轴的对应关系如表 4 中的蓝色部分（可行性评价阶段行）所示。

表 4

GB/T 17766-1999 与 UNFC 各轴对应关系

GB/T 17766-1999		UNFC		
		级	亚级	
经济意义	1	E1	E1.1	经济和社会活力
			E1.2	
	2M	E2		
	2S			
	3			
		E3	E3.1	
	3		E3.2	
			E3.3	
可行性评价阶段	1	F1/F2		项目状态和技术可行性
	2			
	3	F2		
		F3		
		F4		
地质可靠程度	1	G1		地质认知程度
	2	G2		
	3	G3		
	4	G4		

20. GB/T 17766-1999 强调的是可行性评价工作的详细程度，UNFC 强调的是项目所处状态和技术可行性，二者级别不能一一对应。一般情况下，可行性研究或预可行性研究在技术研究方面有两种结果：其一，当前技术条件可以满足矿山建设和生产的需要；其二，项目的技术可行性尚待进一步确认。因此，GB/T 17766-1999 中 F 轴的“1”和“2”均可能对应 UNFC 的 F1 或 F2。

21. GB/T 17766-1999 中“概略研究”是对矿产资源开发技术和经济可行性的概略评价，可应用于矿产勘查活动的各个阶段。普查阶段的概略研究结论可靠程度相对较低，详查和勘探阶段的研究结论可靠程度相对较高，尤其是伴有矿床工业指标论证。概略研究对应于 UNFC 中 F2 或 F3。

22. GB/T 17766-1999 中预查阶段要求开展区域地质研究、特定区块的地质研究和相应的矿产勘查工作，可能估算潜在矿产资源。尽管，其 GB/T 17766-1999 的可行性研究程度代码“3”与概略研究相同，实际上，其可行性评价程度比概略研究低。在此情况下，GB/T 17766-1999 技术可行性程度对应 UNFC 的 F3，如表 4 所示。

23. UNFC 的 F4 在 GB/T 17766-1999 中无对应项。

## C. E 轴的对应

24. GB/T 17766-1999 的 E 轴代表评价当时的经济合理性，划分为：经济的（1）、边际经济的（2M）、次边际经济的（2S）和内蕴经济的（3）。不分亚级。

25. UNFC 的 E 轴代表经济和社会活力，划分成 E1、E2 和 E3 三级，E1 和 E3 划分了亚级。

26. GB/T 17766-1999 中“经济的”代表预可行性研究或可行性研究当时的市场条件下，开采经济上合理，或在政府补贴和其他扶持条件下开发是可能的，对应于 UNFC 的 E1.1、E1.2。

27. “边际经济的”代表预可行性研究或可行性研究当时开采不经济但接近盈亏边界，只有将来条件改善或政府给予扶持条件下可变成经济的，对应 UNFC 的 E2。

28. “次边际经济的”是在预可行性研究或可行性研究当时开采不经济或技术上不可行，当价格大幅度提高和技术进步时才能经济开采，一般情况下，可对应 UNFC 的 E2。

29. “内蕴经济的”针对矿产资源量，为概略研究的结果。代表开采这部分矿产资源在可预见的未来预期经济可行。对应于 UNFC 的 E2。

30. “经济意义未定的”是指由于资料信息不足，尚不能确定经济的可行性，在 GB/T 17766-1999 中仅对应预查阶段获得的潜在矿产资源。对应于 UNFC 的 E3.2。

31. UNFC 的 E3.1 和 E3.3 在 GB/T 17766-1999 没有对应项。

## **V. 类和级的对应**

32. 尽管，在 E 轴和 F 轴的对应方面，GB/T 17766-1999 和 UNFC 不能很好地一一对应，但是，二者可以通过“类”建立对应关系，如表 5 和表 6 所示。

33. GB/T 17766-1999 中“储量”可以对应 UNFC 中的商业项目类。

34. GB/T 17766-1999 中带“b”的“基础储量”一般等于“储量”加相应的“设计损失和采矿损失”。例如，(111b) 等于 (111) 与“设计损失和采矿损失”的总和。UNFC 中没有对应项。

35. 以“2M”开头的“基础储量”对应 UNFC 的潜在商业项目类。

36. 以“2S”开头的“次边际经济资源量”对应 UNFC 的潜在商业项目类。

37. “内蕴经济资源量”对应 UNFC 的潜在商业项目类。

38. “经济意义未定的潜在矿产资源”，即 (334)？，对应 UNFC 的预查项目类。

表 5

GB/T 17766-1999 与 UNFC 类和级的对应关系

GB/T 17766-1999 类别		GB/T 17766-1999 级别				UNFC 类别	UNFC 最低限度级别		
经济的	储量	(111)				商业项目	E1	F1	G1,G2
		(121)	(122)						
	基础 储量	(111b)				UNFC 中没有相应定义			
		(121b)	(122b)						
边际 经济的		(2M11)				潜在商业 项目	E2	F2	G1,G2,G3
		(2M21)	(2M22)						
次边际经 济的	资源量	(2S11)							
		(2S21)	(2S22)						
内蕴 经济的		(331)	(332)	(333)					
经济意义 未定的	潜 在 矿 产 资 源				(334)?	预查项目	E3	F3	G4

表 6

GB/T 17766-1999 与 UNFC E-F 组合对应关系

	F1.1	F1.2	F1.3	F2.1	F2.2	F2.3	F3	F4
E1.1	1	2	3	4				
E1.2	1	2	3					
E2			4	4	5			
E3.1	10	10	10	10	10	10		
E3.2			6	6	6		9	
E3.3			7	7	7	7		8

注：采用矩阵，以表中色块和数字代码表示 E 轴和 F 轴组合关系，是 UNFC 与其它矿产资源储量分类体系（如与 PRMS、CRIRSCO 模板等）进行对接时，常用的方法。其中的数字代码不是 GB/T 17766-1999、UNFC 分类的组成部分。

			UNFC 亚类
经济的	储量	1	正生产
		2	已批准开发
		3	已论证可开发
	基础 储量	UNFC 没有对应项	
边际经 济的	基础 储量	4	待开发
		5	延迟开发
次边际 经济的	资源量	4	待开发
		5	延迟开发
内蕴经 济的	资源量	4	待开发
		5	延迟开发
GB/T 17766-1999 没有对应项		6	开发未明确
		7	开发不可行
		8	原地不可采量
经济意义未定的	潜在矿产 资源	9	预查项目
GB/T 17766-1999 没有对应项		10	预计采出 不销售的量
很少使用的组合			

注：1.表中色块及其中数字代码代表 UNFC 中 E 轴和 F 轴的组合关系，用于表示 GB/T 17766-1999 与 UNFC 的 E 轴和 F 轴的组合对应关系，具体组合关系见表 6 中 E-F 矩阵。2.表中边际经济基础储量、次边际经济资源量、内蕴经济资源量均存在 UNFC 亚类中待开发和延迟开发的情况。

# **Bridging Document between the National Standard of the People's Republic of China Classification for Resources/Reserves of Solid Fuels and Mineral Commodities (GB/T 17766-1999) and UNFC**

**Prepared by the Mineral Resources and Reserves Evaluation Center of Ministry of Land and Resources of in cooperation with the Technical Advisory Group of the Expert Group on Resource Classification<sup>1</sup>**

## *Summary*

This document provides the Bridging Document between the National Standard of the People's Republic of China Classification for Resources/Reserves of Solid Fuels and Mineral Commodities (GB/T 17766-1999) and the United Nations Framework Classification for Resources (UNFC). Bridging Documents explain the relationship between UNFC and another classification system that has been endorsed by the Expert Group on Resource Classification as an Aligned System. They incorporate instructions and guidelines on how to classify estimates generated by application of that Aligned System using the UNFC Numerical Codes. This Bridging Document compares reserves and resources by Categories and Classes of GB/T 17766-1999 to Categories and Classes of UNFC. GB/T 17766-1999, a national standard issued in 1999, applies to mineral exploration planning and deployment, mineral resources and reserves estimation, preparation of reports of mineral resources and reserves for each stage of exploration and development of mineral resources and reserves. This Bridging Document does not affect the independent application of GB/T 17766-1999 and application of GB/T 17766-1999 does not affect any component of UNFC. In the event of any difference between the Chinese language version and any other language version, the Chinese language version shall prevail.

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<sup>1</sup> This Bridging Document was developed by the Mineral Resources and Reserves Evaluation Center of Ministry of Land and Resources in cooperation with the Technical Advisory Group of the Expert Group on Resource Classification. Following review by the Expert Group at its eighth session, 24-28 April 2017, the Bridging Document was issued for public comment from 15 February to 15 April 2018. Development of this Bridging Document has followed the Document Approval Procedure agreed by the Expert Group at its fifth session, April 2014. The Bridging Document is presented to the Committee on Sustainable Energy at its twenty-seventh session for endorsement.



## **I. Introduction**

1. This bridging document between the Classification for Resources/Reserves of Solid Fuels and Mineral Commodities (GB/T 17766-1999) (hereinafter referred to as GB/T 17766-1999) and the United Nations Framework Classification for Resources (hereinafter referred to as UNFC) details the correlation between GB/T 17766-1999 and UNFC.
2. GB/T 17766-1999 is independent of UNFC. This bridging document does not affect the independent application of GB/T 17766-1999.
3. The application of GB/T 17766-1999 does not affect any component of UNFC.

## **II. Overview of GB/T 17766-1999**

### **A. Brief Introduction to GB/T 17766-1999**

4. GB/T 17766-1999, a national standard issued in 1999, applies to mineral exploration planning and deployment, mineral resources and reserves estimation, preparation of reports of mineral resources and reserves for each stage of exploration and development of mineral resources and reserves. It is applicable to the evaluation of mineral resources and reserves, registration, statistics, scheduling, planning, formulation of policies on mineral resources and reserves, and the development of mineral exploration rules, standards and guidelines, and can also serve as the basis for mineral rights transfers and financing for mineral exploration and development.
5. GB/T 17766-1999 classifies Identified Mineral Resources and Undiscovered Resources. Identified Mineral Resources are divided into three classes: Mineral Resources, Basic Reserves and Reserves. GB/T 17766-1999 applies a three-dimensional numerical coding scheme in which quantities are classified based on the three fundamental criteria: Degree of Economic Viability (E), Level of Feasibility Assessment (F) and Degree of Geological Assurance (G). Combinations of these criteria form a three-dimensional system. Figure 1 shows the entire classification and codification of GB/T 17766-1999.

Figure 1

**Classification of GB/T 17766-1999**

Degree of Geological Assurance Classification Category Degree of Economic Viability	Identified Mineral Resources			Undiscovered Resources
	Measured	Indicated	Inferred	Reconnaissance
Economic	Proved Reserves (111)			
	Basic Reserves (111b)			
	Probable Reserves (121)	Probable Reserves (122)		
	Basic Reserves (121b)	Basic Reserves (122b)		
Marginal Economic	Basic Reserves (2M11)			
	Basic Reserves (2M21)			
Sub-Marginal Economic	Mineral Resources (2S11)			
	Mineral Resources (2S21)			
Intrinsic Economic	Mineral Resources (331)	Mineral Resources (332)	Mineral Resources (333)	(334)?
<p>Notes: Codes used in Figure (111 — 334)</p> <p>The first digit refers to economic viability: 1 = Economic; 2M = Marginal Economic; 2S = Sub-Marginal Economic; 3 = Intrinsic Economic? = Economic-Interest Undefined.</p> <p>The second digit refers to level of Feasibility Assessment: 1 = Feasibility Study; 2 = Prefeasibility Study; 3 = Scoping Study.</p> <p>The third digit refers to Degrees of Geological Assurance: 1 = Measured; 2 = Indicated; 3 = Inferred; 4 = Reconnaissance. B = Reserves without deducting any design or mining losses.</p>				

## **B. Characteristics of GB/T 17766-1999**

6. As a Chinese national standard, GB/T 17766-1999 together with all related technique specifications and guidelines for exploration, constitutes a complete standard system for mineral resources in China. It can ensure the orderly, high-quality exploration of mineral resources in China.

7. In the field of estimation and management of mineral resources and reserves, China has noteworthy characteristics.

8. The process of mineral exploration and development is divided into three phases: mineral exploration, mine design and construction, and mine production. Mineral exploration is divided into four stages: reconnaissance, prospecting, general exploration, and detailed exploration.

9. Application of industrial indexes is one of the noteworthy characteristics of GB/T 17766-1999. The industrial indexes proposed for the mineral quality and mining technical conditions under technical and economic conditions during a certain period shall serve as the basis for delineation of an ore body and the estimation of mineral resources and reserves. They generally comprise general industrial indexes and verified industrial indexes of a specific ore deposit. The general industrial indexes are derived from the experience accumulated by the industry in the long-term mineral exploration, technical and economic verification and mining activities. They are generally used in reconnaissance and prospecting stages. The verified industrial indexes of a specific ore deposit come from the technical and economic verification through normative procedures and upon comprehensive consideration of geological, mining, metallurgy, comprehensive utilization, economy, environmental protection, laws and regulations, society and government and other factors by technical personnel of different professions. They are generally used for the general exploration, detailed exploration stages, mine design and construction, and mine production phases. The verification of industrial indexes is essentially a process of prefeasibility study or feasibility study.

10. The content of mineral exploration in China not only includes achieving knowledge of regional geology and ore body geology through geochemical and geophysical surveys and prospecting, mapping, trenching,

drilling, down-hole geophysics etc., but also comprises doing appraisal and research of hydrogeology, engineering, and environmental geology related to mining technical conditions, and doing research of mineralogy, mineral processing and finally smelting to meet mine design and mine production.

11. GB/T 17766-1999 categories correspond directly to mineral exploration and development stages and level of feasibility assessment as shown in Figure 2.

Figure 2

**Correspondence between Phases of Mineral Exploration and Development, Level of Feasibility Assessment and Categories**

<i>Phases of Mineral Exploration and Development</i>		<i>Target</i>	<i>Feasibility Assessment</i>	<i>Application of Industrial Indexes</i>	<i>Categories</i>
Mineral Exploration Phase	Reconnaissance Stage	Find an area with greater potential for mineralization	Quite simple technical and economic assessment	General industrial index	(334)?
	Prospecting Stage	Find a deposit	Scoping study	General industrial indexes	(333), (334)?
	General Exploration Stage	Make a judgment whether the project has any commercial value or not	Prefeasibility study or scoping study	Verified industrial indexes	If a deposit has a potentially commercial value, based on a scoping study, the categories are mainly (332), (333), with a few (334)?; based on a prefeasibility study, the categories are (122b), (333). If it has no commercial value, the exploration project will be finalized, with no resources registered into the national resources or reserves base.
	Detailed Exploration Stage	Conduct detailed exploration to provide grounds for a feasibility study or mine design and development.	Feasibility study, prefeasibility study or scoping study	Verified industrial indexes	Scoping study: (331), (332) and (333). Prefeasibility study: (121b), (122b), (333), (121), (122). Feasibility study: (111b), (122b), (333), (111), (122).
Mine Design and Construction Phase		Complete mine development and construction on schedule.	Mine design	Verified industrial indexes	(111b), (122b), (333), (111), (122).
Mine Production Phase		Achieve commercial production on schedule and meet cash flow requirement and quality specification.	Production plan	Verified industrial indexes	(111b), (122b), (333), (111), (122).

### III. Overview of UNFC

12. UNFC was developed by experts under the auspices of the United Nations Economic Commission for Europe (UNECE) and was published by UNECE. UNFC applies to international energy and mineral research, government resource management as well as the industrial process planning and efficient capital allocation of businesses.

13. UNFC is a generic principle-based system in which quantities are classified based on the three fundamental criteria: economic and social

viability (E), field project status and feasibility (F), and geological knowledge (G), using a three-dimensional numerical independent coding scheme. Combinations of these criteria form a three-dimensional system.

14. Each criterion (axis) is divided into various categories. For example, the F axis is divided into three categories: F1, F2 and F3, and each category is further divided into a number of sub-categories (for example, F1 is further divided into F1.1, F1.2 and F1.3). The specific classification is shown in Figure 3.

Figure 3

**UNFC Classes and Sub-classes Defined by Categories and Sub-categories**

UNFC Classes Defined by Categories and Sub-categories						
Total Commodity Initially in Place	Extracted	Sales Production				
		Non-sales Production				
	Class		Sub-class	Categories		
				E	F	G
	Known Deposit	Commercial Projects	On Production	1	1.1	1,2,3
			Approved for Development	1	1.2	1,2,3
			Justified for Development	1	1.3	1,2,3
		Potentially Commercial Projects	Development Pending	2	2.1	1,2,3
			Development On Hold	2	2.2	1,2,3
		Non-Commercial Projects	Development Unclassified	3.2	2.2	1,2,3
			Development Not Viable	3.3	2.3	1,2,3
		Additional Quantities in Place		3.3	4	1,2,3
	Potential Deposit	Exploration Projects	No sub-classes defined	3.2	3	4
		Additional Quantities in Place		3.3	4	4

## IV. Alignment of Axes

### A. Alignment of the G Axis

15. In GB/T 17766-1999, the G axis represents the degrees of geological assurance, representing the confidence in exploration results, and is divided into four categories: (i) Measured; (ii) Indicated; (iii) Inferred; (iv) Reconnaissance.

16. In UNFC, the G axis represents geological knowledge and is divided into four categories.

17. The categories of the G axis of GB/T 17766-1999 and UNFC essentially correspond to each other one on one as shown in the grey area (Degree of geological assurance rows) in Figure 4.

Figure 4

**Alignment of the Axes of GB/T 17766-1999 and UNFC**

GB/T 17766-1999		UNFC		
		Category	Sub-Category	
Degree of Economic Viability	1	E1	E1.1	Economic and Social Viability
			E1.2	
	2M	E2		
	2S			
	3			
		E3	E3.1	
	3		E3.2	
			E3.3	
Level of Feasibility Assessment	1	F1/F2		Field Project Status and Feasibility
	2			
	3	F2		
		F3		
		F4		
Degree of Geological Assurance	1	G1		Geological Knowledge
	2	G2		
	3	G3		
	4	G4		

## **B Alignment of the F Axis**

18. In GB/T 17766-1999, the F axis represents the level of feasibility assessment and is divided into three categories: (i) Feasibility study, (ii) Prefeasibility study, and (iii) Scoping study. No sub-category is defined.

19. In UNFC, the F axis represents the field project status and feasibility and is divided into four categories: F1, F2, F3 and F4, in which F1 and F2 can be divided into sub-categories. The alignment of the F axis is shown in the blue area (Level of feasibility assessment rows) in Figure 4.

20. GB/T 17766-1999 emphasizes the level of the feasibility assessment, and UNFC emphasizes field project status and technical feasibility. Their categories do not directly correspond to each other. Generally, a feasibility study or prefeasibility study on the technical factors may have two results: one is that the current technical condition can meet the requirement of a mine development or production; the other is that the technical feasibility of the project needs to be confirmed further. Therefore, both categories “1” and “2” of the F axis in GB/T 17766-1999 may correspond to F1 or F2 in UNFC.

21. A scoping study in GB/T 17766-1999, which is a preliminary assessment of the technical and economic viability for the development of mineral resources, may apply to all stages of mineral exploration activities. The conclusions of the scoping study in the prospecting stage have a relatively low degree of confidence. The conclusions of the scoping study based on general exploration and detailed exploration have a higher degree of confidence, especially with verification of industrial index. The scoping study corresponds to F2 or F3 in UNFC.

22. At the reconnaissance stage in GB/T 17766-1999, it is required that local geological studies and exploration activities, site-specific geological studies and exploration activities should be done and Undiscovered Resources may be estimated. The category of the level of the feasibility assessment at this stage in GB/T 17766-1999 is 3. In this case, the level of the technical feasibility in GB/T 17766-1999 corresponds to F3 in UNFC as shown in Figure 4.

23. F4 in UNFC is not defined in GB/T 17766-1999.



### **C. Alignment of the E Axis**

24. In GB/T 17766-1999, the E axis represents the evaluation of the economic rationality at the time, and is divided into 4 categories: Economic, Marginal Economic (2M), Sub-Marginal Economic (2S) and Intrinsic Economic. No sub-categories are defined.
25. In UNFC, the E axis represents economic and social viability, and is divided into E1, E2 and E3 categories. E1 and E3 can be divided into sub-categories.
26. In GB/T 17766-1999, “Economic” represents the fact that the prefeasibility or feasibility study shows that extraction at the time is economically reasonable under the market conditions, or it is possible to develop with assistance from government subsidies and other forms of assistance. It corresponds to E1.1, E1.2 sub-categories in UNFC;
27. “Marginal Economic” represents the fact that the prefeasibility or feasibility study shows that extraction at the time is uneconomic, but may become economic as a result of improved conditions or through other supportive measures of governments in the future. It corresponds to E2 in UNFC.
28. “Sub-Marginal Economic” represents the fact that the prefeasibility or feasibility study shows that extraction at the time is not economic or is not technically feasible and would require substantially higher commodity prices or a major cost-reducing advance in technology before it becomes economic. Generally, it corresponds to E2 in UNFC.
29. “Intrinsic Economic” refers to the mineral resources which have been through a scoping study. It represents the fact that extraction of the mineral resources is expected to become economically viable in the foreseeable future. Category “Intrinsic Economic” corresponds to E2 in UNFC.
30. “Economic-Interest Undefined”, where it is impossible to determine its degree of economic viability due to insufficient information, only corresponds to undiscovered resources achieved at the reconnaissance stage in GB/T 17766-1999. It corresponds to E3.2 in UNFC.
31. E3.1 and E3.3 in UNFC are not defined in GB/T 17766-1999.

## V. Alignment of Classes and Categories

32. GB/T 17766-1999 and UNFC do not correspond to each other very well at the level of the E and F axes, but they may correspond between classes as shown in Figure 5 and Figure 6.

33. “Reserves” in GB/T 17766-1999 correspond to the “Commercial Projects” class in UNFC.

34. “Basic Reserves” with “b” in GB/T 17766-1999 generally correspond to “Reserves” plus relevant design or mining losses. For example, (111b) equals to (111) plus (design or mining losses). They are not defined in UNFC.

35. “Basic Reserves” beginning with “2M” corresponds to the “Potentially Commercial Projects” class in UNFC.

36. “Mineral Resources” beginning with 2S in GB/T 17766-1999 correspond to the “Potentially Commercial Projects” class in UNFC.

37. “Intrinsic Economic Mineral Resources” correspond to “Potentially Commercial Projects” class in UNFC.

38. “Economic-Interest Undefined Undiscovered Resources”, that is (334)?, correspond to the “Exploration Projects” class in UNFC.

Figure 5

### Mapping of GB/T 17766-1999 to UNFC Classes and Categories

GB/T 17766-1999 Classes		GB/T 17766-1999 Categories				UNFC Classes	UNFC "minimum" Categories		
Economic	Reserves	(111)				Commercial	E1	F1	G1,G2
		(121)	(122)			Projects			
	Basic	(111b)				Not defined in UNFC			
		(121b)	(122b)						
Marginal Economic	Reserves	(2M11)				Potentially			
		(2M21)	(2M22)						
Sub-Marginal Economic	Mineral	(2S11)				Commercial	E2	F2	G1,G2,G3
		(2S21)	(2S22)						
Intrinsic Economic	Resources	(331)	(332)	(333)					
Economic-Interest Undefined	Undiscovered Resources				(334)?	Exploration Projects	E3	F3	G4

Figure 6

**Mapping of GB/T 17766-1999 to UNFC by E and F Axes**

	F1.1	F1.2	F1.3	F2.1	F2.2	F2.3	F3	F4
E1.1	1	2	3	4				
E1.2	1	2	3					
E2			4	4	5			
E3.1	10	10	10	10	10	10		
E3.2			6	6	6		9	
E3.3			7	7	7	7		8

			UNFC Sub-Classes
Economic	Reserves	1	On production
		2	Approved for Development
		3	Justified for Development
	Basic Reserves	Not defined in UNFC	
Marginal Economic	Basic Reserves	4	Development Pending
		5	Development On hold
Sub-Marginal Economic	Mineral Resources	4	Development Pending
		5	Development On hold
Intrinsic Economic	Mineral Resources	4	Development Pending
		5	Development On hold
Not defined in GB/T 17766-1999		6	Development Unclassified
		7	Development Not Viable
		8	Additional Quantities in Place
Economic-Interest Undefined	Undiscovered Resources	9	Exploration Project
Not defined in GB/T 17766-1999		10	Quantities forecast to be extracted but not for sale
Less Common Mappings			