

GENERAL SPECIFICATION

GEOLOGY

GS EP GLG 203

Quantitative Mineralogical analysis

01	06/2015	Organisation change – January 2015
00	09/2013	First Issue
Rev.	Date	Purpose of the revision

Document update realised by
standards coordination
Reorganisation 2015

Owning entity: EXPLO/GTS

Managing entity: EXPLO/GTS/ISS

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1. Scope

This document defines requirements and recommendations on the techniques to be used for quantitative mineralogical analyses, according to standards defined by Total laboratory experts (EXPLO/GTS/ISS/RGM).

Its objective is to ensure the same level of quality of quantitative mineralogical analysis results, whether they are performed in Total laboratories or provided by service companies ones, and regardless of the geological context (conventional clastics and carbonates reservoir rocks, non conventional reservoirs such as shales or tight formations).

Quantitative Mineralogy relies on analytical mineralogy results generated from X-ray diffraction and reconciled with chemical and physical analyses on the same sample. Other related techniques, using X-ray diffraction only, or such as calcimetry or point counting of thin sections, are typically semi-quantitative at best and are not addressed in this document

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
Not applicable	

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
Not applicable	

3. Foreword

The mineralogical composition of rock formations is a fundamental data in a number of domains of oil industry (geology, petrophysical reservoir characterisation, drilling and production). Geologists and reservoir engineers need mineralogical data because it is a key input parameter to log petrophysical interpretation (impacting directly net pay estimation), core petrophysical synthesis and rock typing (establishing relationships between petrophysical behaviour and geology through mineralogy). Drilling engineers need mineralogy information for wellbore stability insurance, development engineers need it for fluid-rock interactions prediction from well performance, production mechanism efficiency, and installation integrity evaluations. Numerous

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commercial laboratories are proposing mineralogical analyses often sold as “quantitative”, using their own analytical methods and procedures.

This General Specification provides a single reference methodology allowing providing high quality results, equivalent to the ones provided by Total laboratories. An extensive quality control of external data sets is always necessary to evaluate errors and deviations (twin samples), as quantitative mineralogy approach involves multiple analysis leading to multiple sources of error, and is strongly dependent upon interpreter experience.

4. Sampling

4.1 Suitable samples

Mineralogy can be determined using different types of samples taken from conventional cores, sidewall cores, or cuttings (Appendix 1, Fig. 1).

If available, only conventional cores and side wall cores shall be used as samples. They shall be cleaned of drilling mud and rock powder on the outer surface.

Well cuttings, especially cuttings that have been cleaned on the rig, are not recommended as ideally suited for mineralogical purposes: an important level of uncertainties is associated with pollutions by drilling mud additive (which may be very difficult to remove by sample cleaning) and poorest cuttings representativeness (depth uncertainty, loss of fine sediment fraction, possible mix up with fallen down elements from upper levels). It is necessary to be particularly careful during sampling, to prevent problems of representativeness. Ideally, every petrophysical measured sample should be mineralogically qualified with 3 to 4 samples per m of core, this figure being adjusted according to the formation heterogeneity.

4.2 Recommended sample size

- **A minimum of 20 grams of material is requested per sample** in order to ensure a correct representativeness and precision of the analysis (analysis remains possible with 10 grams but with a higher uncertainty level).
- It is recommended to systematically collect a little more material so that enough remains after the initial analysis if complementary tests become necessary.

NB: two successive samplings on a given sample are never strictly identical, due to fine-scale mineralogical variations (cm-scale variations and/or presence of concretions or fossil tests) and the potential differences are strongly dependent on the geologic nature of the sample.

5. XRD analysis and its limitations

Quantitative mineralogical analysis is commonly based on bulk powder X-ray diffraction (XRD).

In the Total methodology, XRD is used to identify mineral species present in the sample and to provide a first approximation of their proportions. The obtained results are then reconciled with chemical and physical analyses on the same sample to provide quantitative mineralogical data.