306001

Yolla-1 Service Report.

Core Petrology and Geochronology.

Contents

OR-0312

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YOUR REFERENCE: Local Purchase Order 475

IDENTIFICATION: Yolla-1, core no. 2

WORK REQUIRED: Geochronology

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1. INTRODUCTION

Two boxes of core (approximately 1.5 m) were received from Mr W. Moehl of AMOCO with a request to carry out a petrographic examination toselect the most suitable sample on which to carry out an urgent K-Ar age determination. The magnetic susceptibility of the core was also to be measured.

2. PROCEDURE

A visual examination of the core suggested that the rock was fairly homogeneous and so two thin sections, from 3345.1 m and 3345.8 m, were prepared (TSC 45791, 45792).

Microscopic examination of the sections indicated that this core is totally unsuitable for geochronology (see below) and Mr Moehl was advised by telephone on 23 August, 1985. After further discussion it was agreed that an attempt would be made to date a sample of basalt submitted earlier (Junk Sub. 3173 m). This sample was originally rejected for dating because it contained carbonate and chloritic alteration but re-evaluation of the thin section suggested that much of the alteration to chlorite was from a non K-bearing phase (possibly olivine). The loss of argon due to alteration of the primary phases may therefore not be as severe as originally thought.

A total rock sample was prepared by crushing the rock and screening out the 0.85-0.25 mm fraction. In an attempt to remove any surface or exposed vein carbonate before analysis, this fraction was washed in dilute hydrochloric acid, rinsed in water and dried. A portion of the 0.85-0.25 mm fraction was pulverised and analysed for K. The remaining material was analysed for radiogenic argon.

3. MAGNETIC SUSCEPTIBILITY

Several measurements of magnetic susceptibility were made at 0.1 m intervals along the core. These measurements fall into two groups, listed below in Table 1:

TABLE 1: MAGNETIC SUSCEPTIBILITY MEASUREMENTS (S.I. UNITS)

Uppermost 0.1 m	:	$65-85 \times 10^{-6}$
Remaining core	:	$150-250 \times 10^{-6}$

4. PETROGRAPHIC DESCRIPTIONS

Yolla No. 1, 3345-3346 m, TSC45971, 45972

Rock Name: Altered amygdaloidal basalt

The two samples, from 3345.1 and 3345.8 m are similar in most respects and a single description of the two samples is given, with special mention being made of features present in only one of the sections.

The rock is so extensively altered that virtually none of the primary mineral phases remain. However, many of the original textures can still be distinguished. The rock is basaltic in nature and shows amygdaloidal, porphyritic and fluidal textures.

The amygdales are rounded to oval and, in the thin section, are up to 5.0 mm in diameter. Their abundance is difficult to estimate but they comprise possibly 25-30% of the rock. The amygdales are composed predominantly of carbonate and chlorite, sometimes showing a concentric mineral zoning. Silica is also common, both as quartz and chalcedony and is particularly well developed in the amygdales at 3345.8 m.

Altered phenocrysts up to 1 mm in length make up 10 -15% of the rock. Crystal outlines are well preserved and suggest that both olivine and pyroxene were once present. Rare traces of pyroxene remain but the phenocrysts are almost totally replaced by chlorite and secondary micaceous minerals.

Plagioclase occurs mainly in the groundmass although a few laths up to 0.6 mm inlength may be classed as phenocrysts. Most lath-like shapes are less than 0.2 mm in length and about 0.02 mm in width. The groundmass is now replaced by chlorite and weakly amsotropic ?zeolites. Small patches of carbonate are abundant, scattered throughout the groundmass, and appear to be replacing plagioclase.

A poorly defined fluidal texture is enhanced by the distribution of opaque grains along the prismatic sides of the plagioclase laths. The opaques comprise about 5% of the rock and are frequently elongated and of irregular shape, suggesting that much of it may be of secondary origin e.g. exsolved or redistributed Ti oxides.

These samples are far too altered to be suitable for K-Ar dating and the high carbonate content would make such work technically impossible.

Yolla No. 1, Junk Sub. 3173 m, TSC45650

This sample of basalt was initially rejected as being too altered for dating but was re-examined after the above samples were rejected.

This rock is a fine grained porphyritic basalt in which the phenocrysts have been altered to a pale green serpentine/chlorite mixture, with minor carbonate.

Very fresh, fine, plagioclase laths, up to 0.1 mm in length and small (up to 0.040 mm) granules of fresh pyroxene are set in a mainly feldspathic groundmass that shows an incipient pale green almost isotropic(?) alteration. The interstitial nature of some of this material suggests that it may be partly glassy.

Very fine flakes of biotite are present in minor amounts.

Black opaque Fe oxide granules, often with square outlines, make up 5-7% of the rock.

The alteration of the phenocrysts (which contained virtually no potassium) would not affect the suitability of the sample for dating but the late stage phases of the groundmass, in which the K is normally concentrated, also show signs of alteration. Consequently, K-Ar dating can be expected to give only a minimum estimate of the age of crystallisation.

The presence of small amounts of carbonate may not present an insurmountable difficulty in the argon extraction procedure and could possibly be removed (or partly removed) by washing the sample in dilute hydrochloric acid.

5. GEOCHRONOLOGY

The K and Ar analyses and calculated K-Ar age for the total rock sample from the junk sub., 3173 m sample are given in Table 2.

The measured age pf 54 Ma (very early Eocene) must be considered to be only a minimum age of crystallisation of this basalt because of the alteration of some mineral phases. While much of the alteation appears to be a chlorite or serpentinitic replacement of phenocrysts (possibly olivine) and may therefore have little influence on loss of radiogenic argon from the rock, the alteration of the interstitial groundmass phase, where much of the K is expected to be concentrated, would play a more significant part in producing argon loss.

It is this latter, although minor alteration which requires a cautious interpretation of the measured age to be made. Unfortunately, no quantitative estimate of argon loss is possible, but from experience, it is certain that some loss has occurred and the real age of the sample may be as old as Paleocene or Cretaceous. Thus, the 'geological' error is probably much greater than the analytical error quoted in Table 2.

TABLE 2: POTASSIUM-ARGON RESULTS

Sample	%K	$^{40}Ar^*$ ($\times 10^{-10}$ moles/g)	$^{40}Ar^*/^{40}Ar_{Total}$	Age†
Basalt, 3173 m	1.357	1.2921	0.958	54.1±0.6
(junk sub.)	1.357			

*Denotes radiogenic ^{40}Ar.

†Age in Ma with error limits given for the analytical uncertainty at one standard deviation.

Constants: ^{40}K = 0.01167 atom %

β = $4.962 \times 10^{-10} y^{-1}$

ϵ = $0.581 \times 10^{-10} y^{-1}$