PARTICULATE ORGANIC MATTER ANALYSES AND OIL POTENTIAL OF THE NAPO GROUP, SUBANDEAN ZONE, ECUADOR

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INTRODUCTION

The Subandean Zone of Ecuador (SAZ) is the westernmost and proximal part of the Oriente Basin. In this area the Paleozoic basement and the Mesozoic to Tertiary volcanic and sedimentary formations are exposed in large-scale antiforms and thrust slices. This architecture is due to the eastward thrusting of the Cordillera Real over the Guyana Shield and Oriente Basin fill series.

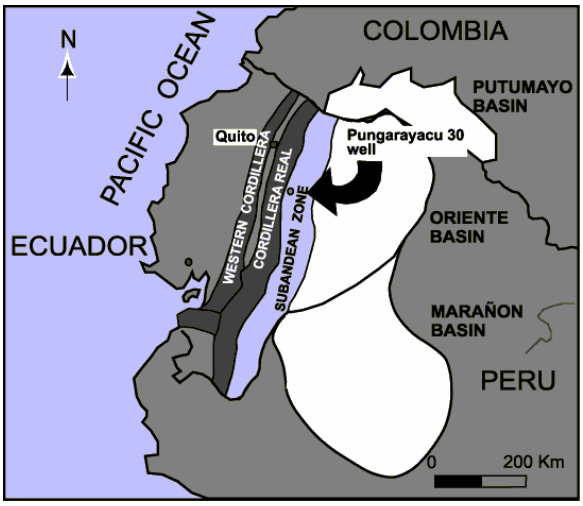

Figure 1. Location Map

The Napo Group is a sedimentary series including organic rich shales, sandstones and limestones of Late Albian to Campanian age. It is subdivided in four formations: Napo Basal, Lower Napo, Middle Napo and Upper Napo (Jaillard, 1997), which were deposited in the epicontinental Oriente Basin (Fig. 1). This basin has yielded the

majority of hydrocarbons that have been extracted from the Putumayo-Oriente-Marañon oil province (Rivadeneira & Baby, 1999). Sandstones of the Napo Group are the main oil reservoir rocks in the Oriente Basin, whereas organic rich intervals are assumed to be the oil source rock.

In this study we use sedimentological, and particulate organic matter (POM) data, in order to reconstruct the depositional environment, and to evaluate the oil source potential of the Napo Group. For this we have selected the Pungarayacu 30 well (Fig. 1), which contains the most complete record of the Napo Group in the SAZ, including the oil reservoir rocks and the presumed oil source intervals.

DISCUSION

Based on POM and sedimentological evidence (Fig. 2), several stratigraphic sequences have been recognized within the Napo Group in the Pungarayacu 30 well. These sequences are comprised in two larger scale sedimentary stages: the first one including the Napo Basal and Lower Napo Formations is characterized by important input of terrestrial derived phytoclast and palynomorphs (up to 90%), deposited during well-developed lowstand system tracts (LST). Whereas in the second stage (Middle and Upper Napo Fm.) the POM assemblages are characterized by high abundance of well preserved (fluorescent) amorphous organic matter (AOM), a general decrease in the terrestrial derived material, and high TOC values, ranging between 9,8–12%. Anoxic-dysoxic conditions, that enhanced the preservation of the organic matter, produced high quality source rocks. During this latter stage, restricted marine environments prevailed and LSTs are not preserved or are of minor importance.

According to paleogeographic reconstructions (Pindell & Tabbutt, 1995), the northwestern South American basins were connected during the Late Cretaceous. During most of this period, the Ecuadorian segment was probably separated from the Pacific Ocean by a proto-Cordillera Real, which isolated the basin from open marine conditions, enhancing organic matter preservation by restricted water circulation. Such barriers have been also recognized for contemporaneous formations in Colombia (Villeta Fm.) and in Venezuela (La Luna Fm.), where they are also assumed to play a role in the development of anoxic bottom waters. The described POM and paleontological data (e.g. oysters) and the high accumulation rate of organic matter, suggest a prevailing shallow water column (ca. 20-40 m deep), where oxidative and respiratory losses were minimal, allowing the preservation of the organic matter in sediments.

In the studied well, oil prone intervals are found in the Middle Turonian interval, corresponding to the Lower A Limestone and Lower M2 Limestone Members (Fig. 2). They are characterized by high abundance of well preserved AOM (up to 70%) associated with high TOC values (10–12%). Time equivalent sediments in Colombia and Venezuela have been related to maximum flooding events, that allowed the preservation of organic matter in anoxic bottom water conditions (Erlich *et al*., 1999; Ramon *et al*., 2001). Therefore, this interval is regionally identified and corresponds to a widespread event. However, according to our data it does not coincide with the early Turonian global flooding event (OAE2). In the Oriente Basin this event seems to fall

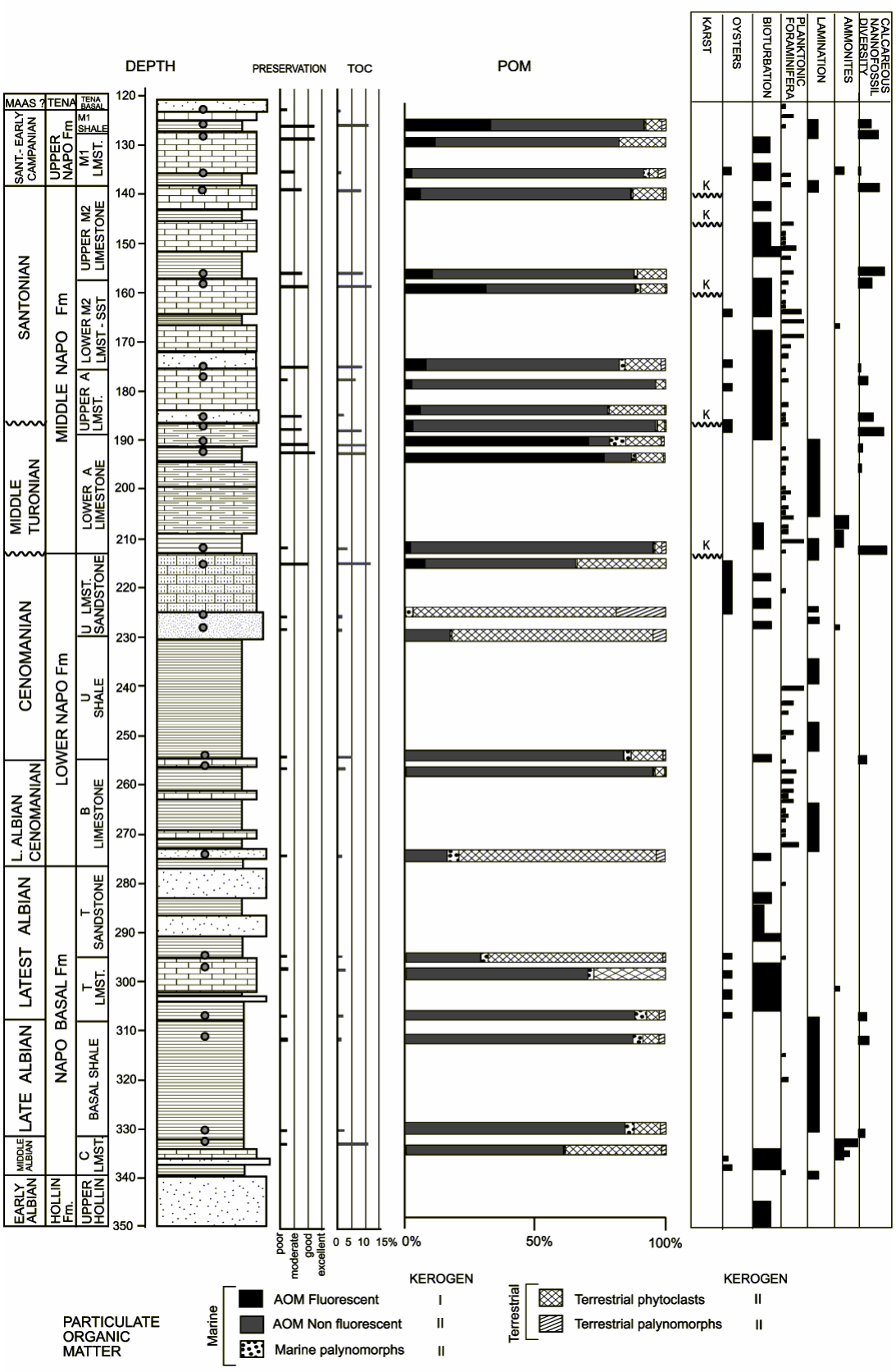

Figure 2. Lithostratigraphy, sedimentary structures (modified from Jaillard, 1997), TOC, preservation and POM of the Pungarayacu 30 well.

within the Early Turonian hiatus.

The colour of palynomorphs is used as a direct indicator of thermal maturation. In the Pungarayacu 30 well the colour of the palynomorphs varies between pale yellow to yellow, corresponding to a value of 2 in the Thermal Alteration Scale (TAS of Batten, 1982). This correlates well with average T max values of 428°C, as determined by pyrolysis. Vitrinite reflectance of values 0.4–0.5% from the same area are also in line with these features. These data indicate thermally immature conditions for oil generation, with an equivalent temperature being below 60 °C.

The origin of the oil accumulation in the Pungarayacu area remains to be explained. Thermally immature conditions of the sediments indicate that they were not able to generate major quantities of liquid hydrocarbons. It is possible that the oil was generated and migrated from an equivalent source of a neighboring area, or that it was sourced from pre-Cretaceous rocks of which the oil potential remains to be proved.

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