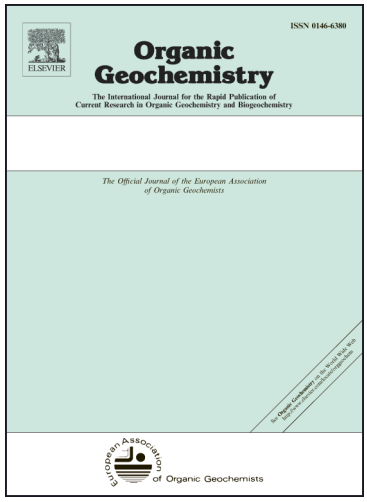

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Andrea Schito, Claudia Romano, Sveva Corrado, Domenico Grigo, Brent Poe

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Diagenetic thermal evolution of organic matter by Raman spectroscopy

Andrea Schito [a], Claudia Romano [a], Sveva Corrado [a], Domenico Grigo [b], Brent Poe [c]

[a] Dipartimento di Scienze, Sezione di Scienze Geologiche, Università degli Studi Roma Tre, L.go S. Leonardo Murialdo 1, 00146, Roma, Italy
[b] Eni SpA e Exploration & Production Division, Via Emilia, San Donato Milanese, MI, 20097, Italy
[c] Dipartimento di Geotecnologie per l'Ambiente ed il Territorio, Università degli Studi "G. d'Annunzio" – Chieti, Via dei Vestini 30, 66013 Chieti Scalo, Italy

Corresponding author.

E-mail address:**andrea.schito@uniroma3.it**

Keywords: thermal maturity; dispersed organic matter; Raman spectroscopy; diagenesis

Abstract

Vitrinite reflectance is considered one of the most reliable indicators of thermal maturity in sedimentary basins and is widely used to calibrate numerical models that assess hydrocarbon generation/expulsion from source rocks. Nevertheless, ambiguities in vitrinite reflectance can occur from variations in composition and preservation state of organic facies, temperature/ pressure conditions and the abundance of organic matter resulting in incorrect or uncertain assessments of petroleum systems.

This study presents an original application of Raman spectroscopy to assess the diagenesis - catagenesis of kerogen between the immature and mid-mature stages of hydrocarbon generation. Kerogens were isolated from 33 intervals of drill cuttings from a 5 km thick Oligocene-Miocene siliciclastic section of the Malembo Formation (Lower Congo Basin, Angola). Their Raman spectra were obtained and derived parameters were compared to depth and to previously reported equivalent vitrinite reflectance values. The best correlations between thermal maturity and Raman parameters were found for D-G band distance; FWHM of the G band; D/G area ratio; RA2 ratio (calculated as S+Dl+SD/Dr+Gl+G band ratio) and the D/G width ratio. The Raman parameters were not influenced by varying kerogen composition (mixed type II/III). The technique offers the potential to reduce the risk of source rock thermal maturity assessment even when organic facies rich in amorphous organic matter are present.

1 Introduction

Quantitative evaluation of the thermal maturity of organic matter (OM) dispersed in sediments is a key element in assessing the processes of hydrocarbon (HC) generation/expulsion in petroleum systems. It is linked to the thermal evolution of sedimentary basins and orogenic belts (Corrado et al., 2010; Allen and Allen, 2013; Hackley and Cardott, 2016). Vitrinite reflectance analysis is considered a highly reliable and