Available online at www.sciencedirect.com

ScienceDirect

Russian Geology and Geophysics 55 (2014) 726–736

RUSSIAN GEOLOGY AND GEOPHYSICS

www.elsevier.com/locate/rgg

Naphthides of continental hydrotherms (*Uzon, Yellowstone, New Zealand*): geochemistry and genesis

E.A. Fursenko [a,b,*], V.A. Kashirtsev [a,b], A.E. Kontorovich [a,b], A.N. Fomin [a,b]

[a] *A.A. Trofimuk Institute of Petroleum Geology and Geophysics, Siberian Branch of the Russian Academy of Sciences, pr. Akademika Koptyuga 3, Novosibirsk, 630090, Russia*

[b] *Novosibirsk State University, ul. Pirogova 2, Novosibirsk, 630090, Russia*

Received 14 November 2013; accepted 26 November 2013

Abstract

We summarize and analyze the available data on naphthide shows in continental zones of active hydrothermal and modern volcanic activity (Uzon Volcano caldera, Yellowstone National Park, and New Zealand springs) and examine their similarity and difference. The analysis demonstrated that hydrothermal naphthides formed from lipids of living matter of different nature: phytoplankton, bacterial communities, archaea, and remains of higher land plants, including spores and pollen, which might have been supplied to the sediment through eolian transportation. Hydrothermal naphthides are different in the degree of maturity, but in general they are less transformed than most of basin oils. Their group composition and distribution of *n*-alkanes evidence that they were subject to hypergenesis, which led to the loss of light fractions, oxidation, and biodegradation.

Keywords: hydrothermal oil; basin oil; organic geochemistry; hydrocarbon biomarkers; Uzon; Yellowstone; New Zealand

Introduction

The nature and chemistry of naphthide shows revealed in a number of the Earth's areas with active hydrothermal activity attract the interest of researchers worldwide. According to some data, their formation is a rapid (few thousand years to decades), almost instantaneous (in geological terms), process of the thermolytic or, in some cases, thermocatalytic transformation of organic matter (OM) induced by the energy of hydrothermal systems (Bazhenova et al., 1998; Beskrovnyi and Lebedev, 1971; Brault et al., 1988; Kalinko, 1975; Karpov, 1988; Kawka and Simoneit, 1987; Kontorovich et al., 2011; Kvenvolden and Simoneit, 1990; Simoneit, 1993; Simoneit and Lonsdale, 1982; Simoneit et al., 2009). Such naphthide shows are natural products unique in composition and generation conditions. Most of them were found in the sediments and bottom waters of hydrothermally active zones of the World Ocean. There are also occasional findings of naphthides in continental zones of dynamic hydrothermal activity and modern volcanism: Uzon Volcano caldera (Kamchatka Peninsula, Russia), Yellowstone National Park (US), and New Zealand (Fig. 1).

In this paper, based on systematization and comparative analysis of data on the composition of naphthides in continental zones of dynamic hydrothermal activity and modern volcanism, we defined their basic similarity and difference features. This provides new valuable information about the sources and generation conditions of hydrocarbon (HC) fluids in such zones.

For accuracy, let us refine the terminology used below.

N.A. Orlov and V.A. Uspenskii proposed to distinguish naphthides and naphthoids (Orlov and Uspenskii, 1936; Uspenskii et al., 1964). According to Uspenskii, naphthoids are a specific genetic class of natural bitumens, which are the product of thermal degradation of OM during contact metamorphism and catagenesis. According to this definition, naphthoids differ from naphthides in the source of thermal energy necessary for OM catagenesis and in the reaction rate of this transformation. Expanding the interpretation of the term proposed by Uspenskii (the heat of not only contact metamorphism and catagenesis but also hydrotherms), hydrothermal oils can be called naphthoids. The drawback of this term is the absence of analogues from English and other languages with developed scientific conceptual and terminological bases. Therefore, the authors of the "Mining Encyclopedia" (M.V. Dakhnova) proposed the following translation of this term into some languages: English—*naphthoids*, German—

* Corresponding author.
E-mail address: FursenkoEA@ipgg.sbras.ru (E.A. Fursenko)

http://dx.doi.org/10.1016/j.rgg.2014.05.015

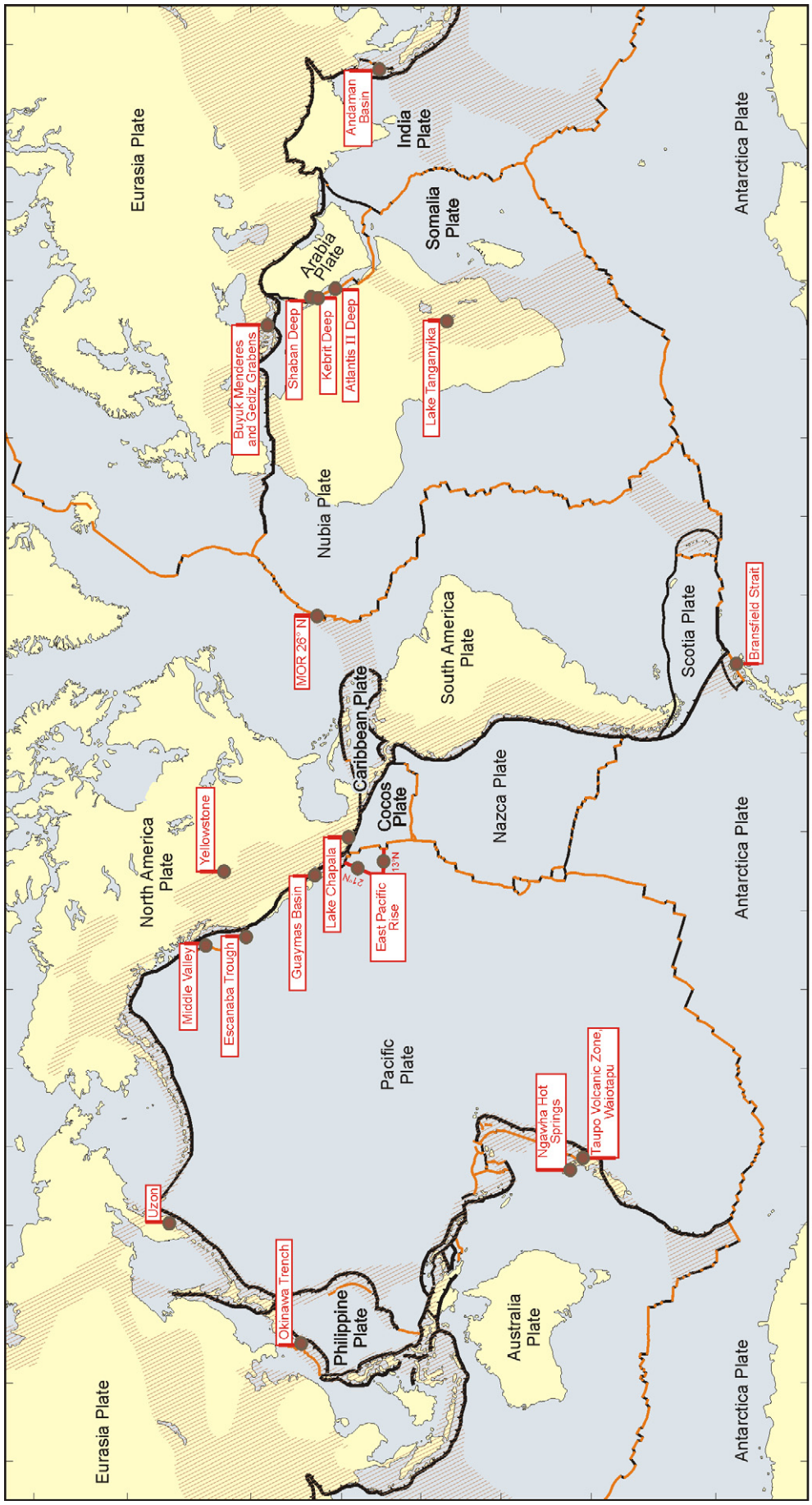

Fig. 1. Scheme of the localization of hydrothermal zones with revealed naphthide shows (elements of lithospheric tectonics, after Simkin et al. (2006)). *1*, present-day hydrothermal systems with revealed naphthide shows; *2*, boundaries of lithospheric plates: *a*, divergent, *b*, convergent, *c*, transform, *d*, diffuse (stacking zones).