Gondwana Research 26 (2014) 834–868

Contents lists available at ScienceDirect

Gondwana Research

journal homepage: www.elsevier.com/locate/gr

GR focus review

A review of batholiths and other plutonic intrusions of Mexico

Fernando Ortega-Gutiérrez [a], Mariano Elías-Herrera [a], Dante J. Morán-Zenteno [a], Luigi Solari [b,*], Laura Luna-González [a], Peter Schaaf [c]

[a] Universidad Nacional Autónoma de México, Instituto de Geología, Cd. Universitaria, 04510 México, D.F., Mexico
[b] Universidad Nacional Autónoma de México, Centro de Geociencias, Juriquilla, Querétaro, Mexico
[c] Universidad Nacional Autónoma de México, Instituto de Geofísica, Cd. Universitaria, 04510, México, D.F., Mexico

ARTICLE INFO

Article history:
Received 12 November 2013
Received in revised form 25 April 2014
Accepted 3 May 2014
Available online 27 May 2014

Handling Editor: M. Santosh

Keywords:
Granite
Batholith
Crustal growth
Mexico
Laramide
Tectonic exhumation

ABSTRACT

Granitic plutons constitute a major portion of the Phanerozoic continental crust of Mexico, with the great majority (ca. 90%) associated to the Laramide Late-Cretaceous–Eocene orogeny and the eastward subduction of the Pacific Ocean plates, as well as to magmatic arcs essentially built since the early Mesozoic at the western margin of North America. Exposed mainly as a wide (up to 300 km) and over 3000 km long batholithic belt at the Mexican Pacific margin from Baja California to Chiapas, granitoids conform large intrusive complexes and hundreds of smaller plutons, the age of which vary from ca. 1400 Ma (Mesoproterozoic) to ca. 10 Ma (late Miocene). In many cases uplift and erosion have revealed the deep roots of the batholiths, whereas in other places many intrusions were emplaced in upper crustal environments, as suggested by the extremely variable cooling rates of >200 °C/Ma (very shallow) to 1–10 °C/Ma (very deep).

Lithologies and isotopic data indicate unambiguously the central participation of the local lower crust in the genesis of the batholiths and plutons, imprinting on them marked petrologic, geochemical and structural zoning across the Paleozoic paleomargins and through the present NW-trending Mexican continental edge according to the lithospheric component involved: Laurentia in the northern and northwestern regions of Mexico, accreted Mesozoic terranes in western Mexico, and Oaxaquia (Gondwana) in eastern and southern Mexico.

Major problems related to the evolution of the Mexican main granitoids are outlined in time slices for the Proterozoic, Paleozoic, Permo-Triassic, Jurassic, Early Cretaceous, Late Cretaceous–Paleogene and Neogene, which represent in Mexico major epochs of crustal growth and continental recycling, mainly associated not only with Pacific–North America convergence, but also with extensional and transpressional events that altogether marked, not only the lithological and structural evolution of most of the country, but also its extraordinary mineral wealth. Finally, some preliminary comparisons (differences and similarities) are made between the Mexican batholiths and other plutonic complexes in Central Asia (Lhasa Terrane) and Japan.

Contents

* Corresponding author.
E-mail address: solari@unam.mx (L. Solari).

http://dx.doi.org/10.1016/j.gr.2014.05.002
1342-937X/

1. Introduction

Granitic rocks sensu lato (alkaline granite to syenite, and tonalite to quartz diorite) and associated mafic and ultramafic intrusions of the continental margins constitute one of the largest components of the middle and upper crust (Vielzeuf et al., 1990; Wedepohl, 1995; Kemp et al., 2007; Condie et al., 2009), and have been continuously generated since Hadean times (e.g. Wilde et al., 2001; Harrison et al., 2005). In addition, intrusions in the continental interiors are generated by distinct tectonic settings, including rifts (e.g. Eby, 1990) and major shear zones (e.g. Ingram and Hutton, 1994). The great majority of these rocks are assembled at convergent margins during subduction of oceanic plates and island arcs interacting with the continental margins, eventually forming the roots of magmatic arcs (batholiths) that commonly extend for thousands of kilometers along the plate margins, such as the Cordillera of western North America (e.g. Hamilton and Myers, 1967), the Andes of South America (e.g. Pitcher, 1978) and the Altaids of central Asia (e.g. Wilhem et al., 2012).

The geologic structure of Mexico is characterized by its youth (<1.85 Ga) and a complex tectonostratigraphic architecture (Table 1) dominated by accreted Paleozoic and Mesozoic orogenic terranes. Although undeformed plutons as old as 1.4 Ga are present, they constitute a very minor proportion of the exposed geology of the country. During the Phanerozoic, the prevalent convergent margin character of the Mexican territory that has been active since the amalgamation of Pangea in the late Paleozoic, imprinted to the middle and upper crust of Mexico a characteristic granitic composition, which is particularly well exposed along its entire western margin, and should also be buried across most of the country, as indicated by the common presence of Paleozoic to Jurassic granitoids found in numerous oil wells drilled in eastern Mexico (Wilson, 1990; Jacobo-Albarrán, 1996; Torres-Vargas et al., 1999), as well as by dispersed outcrops of intrusions of several ages extending from Chihuahua to Oaxaca states. Mexican batholiths thus provide crucial information on the tectonic evolution of the country and adjacent orogenic (i.e. the southern Cordillera) and cratonic (i.e. southwestern Laurentia) domains since the Middle Proterozoic. However, although deformed