Journal of South American Earth Sciences 31 (2011) 298–305

Contents lists available at ScienceDirect

Journal of South American Earth Sciences

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

Fission track and U–Pb *in situ* dating applied to detrital zircon from the Vale do Rio do Peixe Formation, Bauru Group, Brazil

A.N.C. Dias [a], C.A.S. Tello [a,*], F. Chemale Jr. [b], M.C.T.F. de Godoy [a], F. Guadagnin [b], P.J. Iunes [c], C.J. Soares [d], A.M.A. Osório [a], M.P. Bruckmann [b]

[a] *Dep. de Física, Química e Biologia – FCT/UNESP, 19060-900 Presidente Prudente-SP, Brazil*
[b] *Laboratório de Geocronologia,IG-UnB, 70904-970 Brasilia-DF, Brazil*
[c] *Instituto de Física Gleb Wataghin – DRCC/UNICAMP, 13083-970 Campinas-SP, Brazil*
[d] *Instituto de Geociências e Ciências Exatas – IGCE/UNESP, 13506-900 Rio Claro-SP, Brazil*

ARTICLE INFO

Article history:
Received 8 April 2010
Accepted 10 February 2011

Keywords:
Zircon fission track
U–Pb *in situ* dating
Vale do Rio do Peixe Formation
Bauru Group

ABSTRACT

Combined methods of fission track (FTM) and U–Pb *in situ* zircon dating were applied to sedimentary samples from the Vale do Rio do Peixe Formation, Bauru Basin, Brazil. Detrital zircons of nine samples were determined by the FTM, and the obtained ages varied from 239 Ma–825 Ma, which can be grouped into four main populations as the 230–300 Ma, 460–490 Ma, 500–650 Ma and 696–825 Ma groups. The U–Pb data show two clear source areas: the Early Paleozoic to Neoproterozoic zircons, ranging from 445 ± 14 to 708 ± 18 Ma, and the Paleoproterozoic zircons, ranging from 1879 ± 23 to 2085 ± 27 Ma. Subordinate occurrences of Early Neoproterozoic to Mesoproterozoic zircons (836 ± 15 and 1780 ± 38 Ma) were identified. The combined information allows us to characterize Early Brazilian, Brazilian and Rhyacian material as the main source for the zircons, which are areas situated to west of the Bauru Basin (e.g., Goiás Massif) that have been incorporated into the sedimentary cycles in the Phanerozoic (mainly in the Paraná Basin). FT zircon ages reflect the main denudation processes of the South American Plate from Neoproterozoic to Early Triassic as those related to orogenic cycles of Early Brazilian, Brazilian, Famatinian/Cuyanian and Gondwanide.

1. Introduction

In the last decade, the fission track method (FTM) in zircon, in which the fission track age and its thermal history can be determined, has experienced rapid growth and widespread application in the Earth Sciences (Yamada et al., 2003; Hasebe and Watanabe, 2004; Garver, 2003; Dias et al., 2009). Some of the most exciting advances in geochronology have been driven by Laser Ablation Multicollector Inductively Coupled Plasma Mass Spectrometers (LA-MC-ICP-MS). The LA-MC-ICP-MS is well accepted as a reliable and convenient method for dating detrital zircons (provenance information applied to sedimentary basin evolution), mainly after the introduction of Laser Microprobe with 213 nm laser wavelength.

Similar to the FTM, U–Th–Pb geochronology is becoming an increasingly important tool in Earth Science research because it provides improved precision and accuracy, finer spatial resolution, and more efficient data acquisition (Gehrels and Juiz, in press). Analysis of the heavy mineral fraction of clastic sediments has proven to be a useful tool for stratigraphic correlations, especially in sedimentary sequences lacking biostratigraphical markers, stratigraphically distinct horizons or other time constraints such as cross-cutting dykes or sills. In addition, heavy mineral assemblages present in clastic sediments may record sediment sources and/or transport and depositional histories. Age dating of clastic heavy minerals, particularly zircon and monazite, is therefore a powerful tool in sedimentary provenance studies (Kősler et al., 2002). The combination of the two techniques applied to detrital zircons in sediment can provide important information on high-temperature as well as intermediate- to low-temperature geologic events such as the igneous and metamorphic crystallization of zircons and morphotectonic events (e.g., uplift and denudation) as well as the abovementioned sedimentary provenance studies.

The zircon mineral is a common accessory that can be found in igneous, sedimentary and metamorphic rocks and is considered to be the most resistant mineral to weathering and dissolution (Morton and Hallsworth, 1999). Studies about this mineral have

* Corresponding author. Tel.: +55 18 32295355x218.
E-mail address: tello@fct.unesp.br (C.A.S. Tello).

0895-9811/$ – see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.jsames.2011.02.003

been conducted in several geological applications (Tagami, 2005; Watson and Harrison, 2007; Menneken et al., 2007; Tagami and Murakami, 2007; Yamada et al., 2007, 2009).

The main purpose of this work is to determine the apparent and absolute zircon ages extracted from sedimentary rocks from the Vale do Rio do Peixe Formation (Bauru Basin), São Paulo, Brazil, using FTM analysis and U–Th–Pb *in situ* dating with LA-MC-ICP-MS. Because the zircon grains are detrital, they may reveal something about the thermal evolution of their sources. The U–Th–Pb ages may be related to the formation of these minerals, usually as a result of a magmatic crystallization episode, and FTM ages are related to later events of regional cooling, such as the exhumation of the rock units. These apparent ages could be used in provenance studies by correlating them with known geological domains within the regional context.

2. Geological setting

The dated samples are from the Vale do Rio do Peixe Formation, which belongs to Bauru Basin in the North of Parana Basin, São Paulo, Brazil. Fig. 1 shows the geological map of the study area and the location of the samples analyzed in this work. Nine samples (six in Table 2 and three in Table 3) of sedimentary rocks were dated by FTM (reported in the Fig. 3), and three of these samples were analyzed by U–Th–Pb dating (samples ZPI23, ZEM11 and ZCG7 – see Fig. 5).

The Bauru Basin is a Coniacian–Maastrichtian intracratonic continental basin that developed on the central southern part of the South American Platform after the dissolution of Gondwanaland (Fernandes and Coimbra, 1996). The basin substrate consists of basalts of the Eocretaceous Serra Geral Formation (Renne et al., 1992), from which the sedimentary sequence is separated by a regional erosive unconformity (Fig. 2). The Vale do Rio do Peixe Formation (VPF) comprises the largest extension in the basin and constitutes the substratum of most of the West of São Paulo state and Triângulo Mineiro (Minas Gerais). The VPF is deposited above the Serra Geral Formation on the eastern Bauru Basin, whereas in the central part, it covers the Araçatuba Formation. In Fig. 2, different sedimentary stratigraphic units of the Bauru Basin proposed by Fernandes et al. (2003), are shown.

3. Analytical procedures

3.1. Materials and methods

The zircon fission track (FT) ages were obtained using a Leica DMRX microscope at the Departamento de Física, Química e Biologia of UNESP, Brazil. The irradiations for FT analyses were made in the nuclear reactor of IPEN/CNEN in São Paulo state with a neutron fluency of 5×10^{14} neutrons/cm^2. U–Pb zircon dating was carried out at the Isotope Geology Laboratory of Rio Grande University with a laser microprobe (New Wave UP213) coupled to an MC-ICP-MS (Neptune).

3.2. Fission track method

The sample separations were accomplished by conventional techniques of crushing, magnetic separation, and heavy liquids.

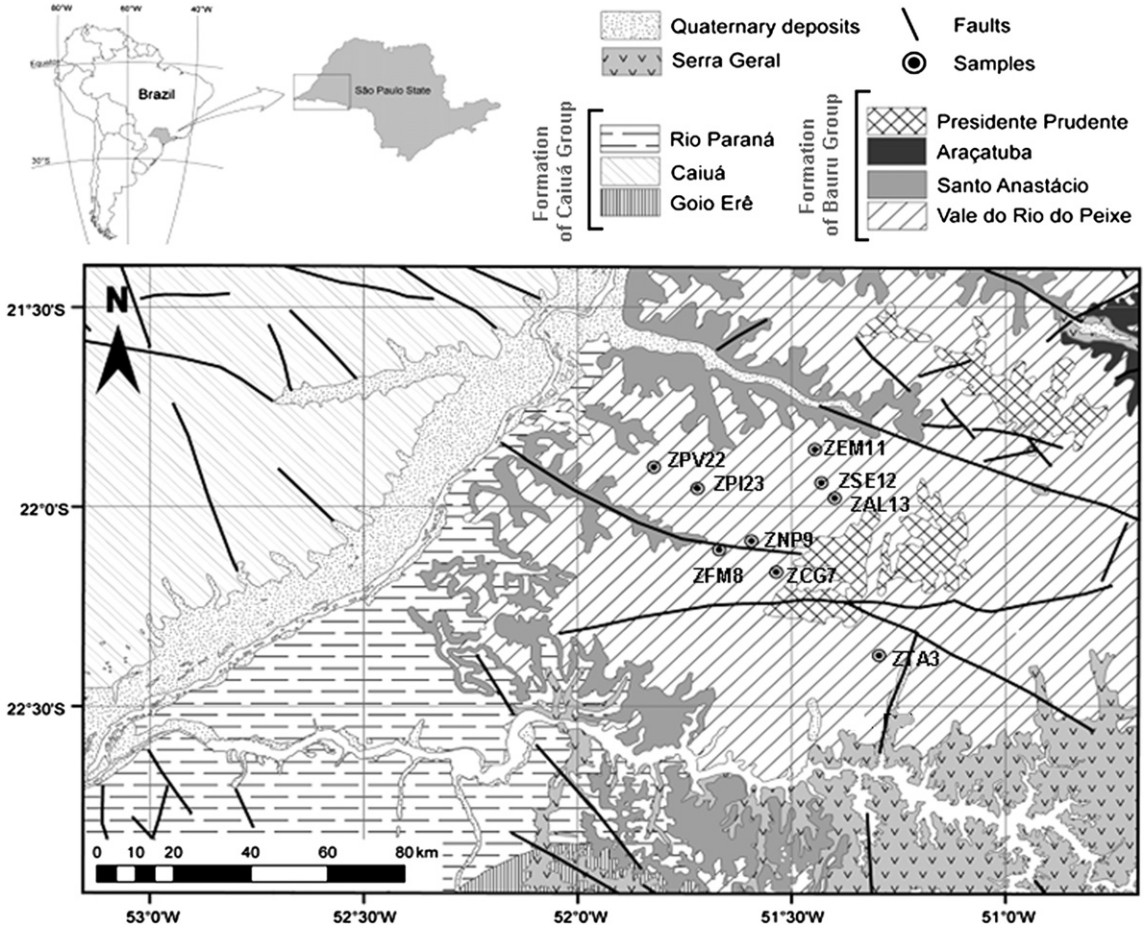

Fig. 1. Geological map of the Bauru Group with location of analyzed samples.