Precambrian Research 234 (2013) 288–321

Contents lists available at ScienceDirect

Precambrian Research

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

Age, Nd–Hf isotopes, and geochemistry of the Vijayan Complex of eastern and southern Sri Lanka: A Grenville-age magmatic arc of unknown derivation

A. Kröner[a,b,*], Y. Rojas-Agramonte[a,b], K.V.W. Kehelpannala[c], T. Zack[a], E. Hegner[d], H.Y. Geng[e], J. Wong[e], M. Barth[a]

[a] Institut für Geowissenschaften, Universität Mainz, 55099 Mainz, Germany
[b] Beijing SHRIMP Centre, Institute of Geology, Chinese Academy of Geological Sciences, Beijing 100037, China
[c] Department of Geology, University of Botswana, Private Bag UB 00704, Gaborone, Botswana
[d] Department für Geo- und Umweltwissenschaften, Universität München, Theresienstrasse 41, 80333 Munich, Germany
[e] Department of Earth Sciences, The University of Hong Kong, Pokfulam Road, Hong Kong, China

ARTICLE INFO

Article history:
Received 5 March 2012
Received in revised form 2 November 2012
Accepted 5 November 2012
Available online 16 November 2012

Keywords:
Sri Lanka
Vijayan
Zircon age
Nd–Hf isotopes
Grenville

ABSTRACT

The ca. 1.0–1.1 Ga Vijayan Complex (VC) of eastern and southeastern Sri Lanka is one of three high-grade metamorphic terranes making up the basement of the island and is in tectonic contact with the adjacent, older Highland Complex. It consists predominantly of granitoid gneisses ranging in composition from diorite to leucogranite, with a distinct calc-alkaline geochemical signature, and is interpreted as a magmatic arc. Strong ductile deformation has obliterated almost all original intrusive relationships. High-grade metamorphism during the Pan-African event at ca. 610–520 Ma has produced widespread granulite-facies assemblages that are now largely retrogressed and were affected by extensive late metamorphic K-metasomatism. In southern Sri Lanka the Vijayan gneisses are tectonically interlayered with rocks of the Highland Complex in a so-called mixed zone. We report zircon ages, whole-rock Nd and Hf-in-zircon isotopic systematics and geochemical data for a large selection of Vijayan gneissses in order to better characterize this complex and its tectonic setting. The zircon ages are predominantly in the range 1100–1000 Ma with a few early Neoproterozoic intrusions, and identify the VC as a Grenville-age magmatic arc. Many zircons experienced minor to significant lead-loss at about 580 Ma. The Nd and Hf isotopic data confirm a generally primitive origin for most Vijayan gneisses, but significant variations in both isotopic systems argue for source heterogeneities and the possible involvement of minor amounts of older continental material in their genesis. Immobile trace and rare earth element distributions favour an origin of the gneiss protoliths through melting at relatively shallow depth, and the chemical variation from diorite and tonalite via granodiorite to granite in the VC can be explained by increasing fractionation of plagioclase and biotite, accompanied by amphibole and accessory phases. The VC may be comparable, in some respect, to the composition and evolution of the Kohistan Arc in Pakistan. The unique composition, age and isotopic characteristics of the VC find no convincing counterpart in other fragments of the Gondwana supercontinent, and its origin therefore remains exotic and enigmatic.

1. Introduction

The high-grade basement terrain of Sri Lanka is generally interpreted as a crustal segment of East Gondwana (Kröner and Brown, 2005 and references therein). Although its rock types, structures, and grade of metamorphism are remarkably similar to those in southern India there are major differences that make a direct correlation difficult (e.g., Kehelpannala, 2004; Kröner and Brown, 2005; Kröner et al., 2003, 2012a). In addition, the amalgamation history of East and West Gondwana is far from resolved, and the position and role of Sri Lanka in this puzzle has been a matter of considerable debate (see Mathavan et al., 1999; Yoshida et al., 2003; Kröner et al., 2003; Kehelpannala, 2004; Collins and Pisarevsky, 2005; Blakey, 2008). For instance, Golynsky and Jacobs (2001) draw an E–W striking (present coordinates) suture zone across central Sri Lanka to satisfy their southern Gondwana reconstruction, but this is simply not present and negates the general N–S structural alignment of most tectonic units (see Fig. 1).

The basement rocks of Sri Lanka (Fig. 1) are subdivided into three major lithotectonic units on the basis of rock type, metamorphic grade and isotopic characteristics (Kröner et al., 1991, 2003; Cooray,

* Corresponding author at: Institut für Geowissenschaften, Universität Mainz, 55099 Mainz, Germany. Tel.: +49 6131 3922163; fax: +49 6131 3924769.
E-mail address: kroener@uni-mainz.de (A. Kröner).

0301-9268/$ – see front matter © 2012 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.precamres.2012.11.001

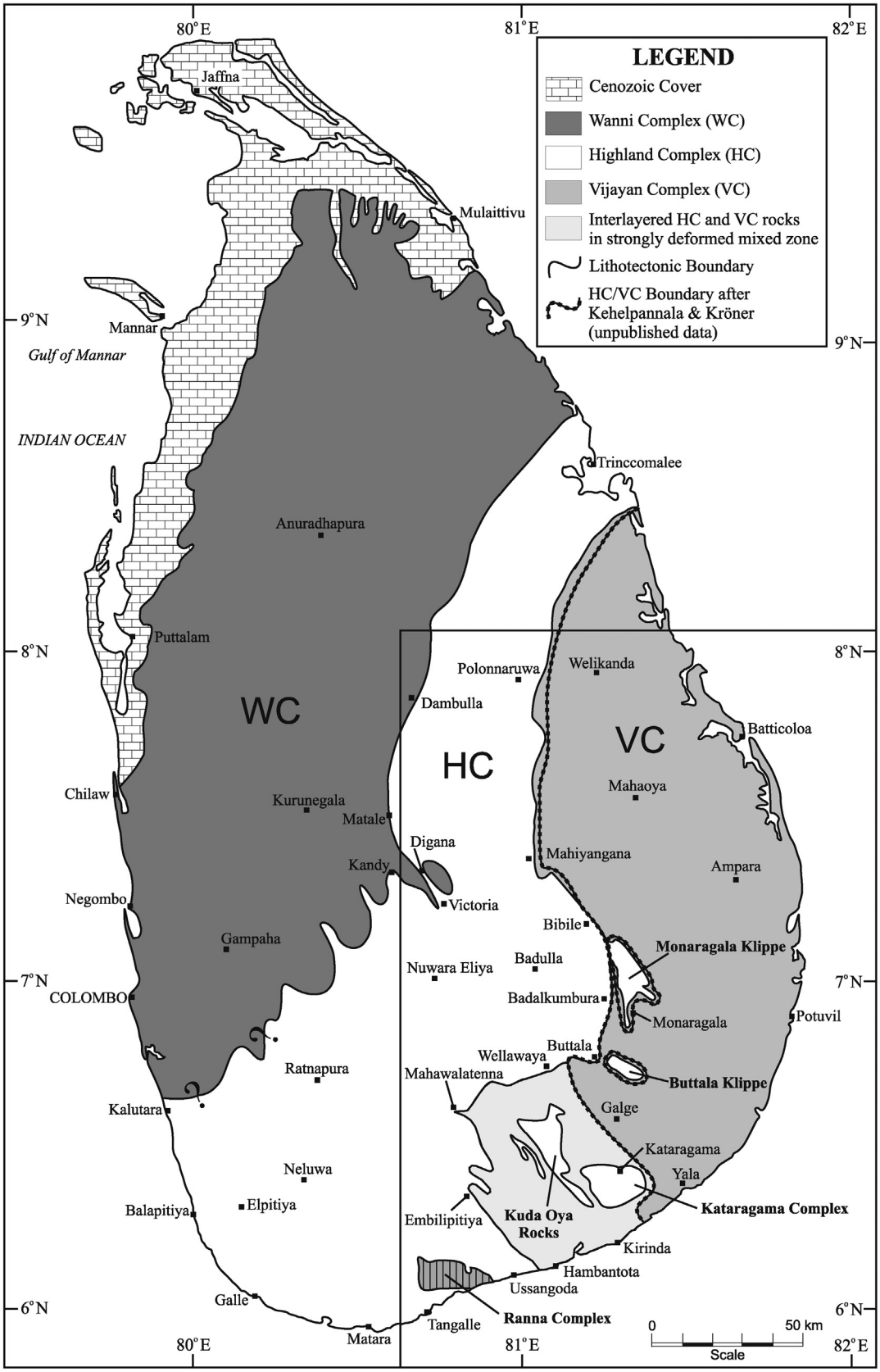

Fig. 1. Overview map of Sri Lanka showing major litho-tectonic units. Location of Fig. 2 is indicated.