Introduction of three granitoid types with different origins from ophiolitic mélange of Nain (Central Iran)

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Introduction

Mesozoic ophiolte melange of Nain is located in Central East Iranian microcontinent. Field studies and petrography indicate presence of three types of granitoids (plagiogranites, high-K granites, and tonalites) with different origins in ophiolitic mélange of Nain. Three granitoid types are different in mineralogy and are including of: (1) Plagiogranites (containing Qtz+Pl+Amp±Prh±Chl) (Mineral abbrevations from [1]); (2) high-K granites (including of Qtz+Pl+Or+Ms+small magmatic Grt (Alm) grains); (3) tonalites that are seen as intruded dikes in the amphibolitic rocks, containing Qtz+Pl+Amp+ small metamorphic Grt (Alm-Sps) grains ±Prh.

Discussion

Plagiogranites are indicated by [2] to be originated of differentiation of primary basalt. Mineral chemistry of garnets in high-K granitoids (almandine) show they have an igneous origin formed through melting of high Ca-Al sedimentary rocks. Garnets in tonalites (almandine-spessartine) have formed by regional metamorphic processes occurred after formation of tonalites (based on Fig. 11 in [3] and Table 1). In Breif, (1) plagiogranites are the final products of primary basalt differentiation, (2) high-K granites have formed through melting of sediments and (3) tonalites have been resulted by some degrees of partial melting and anatexis of their host amphibolite.

Rock Type	High K-granite		Tonalite	
Pyrope	5.63	5.94	13.66	13.71
Almandine	76.07	75.82	45.35	45.76
Grossular	2.28	2.11	4.54	5.20
Spessartine	16.02	16.09	36.40	35.25

Table 1: End members percent of garnets.

[1] Kretz (1983) *Am Min* **68**(1/2), 277–279 [2] Rezai (2006) *M.Sc.Thesis University of Isfahan, Iran* 139. [3] Harangi *et al.* (2001) *J Pet* **42**(10), 1813–1843.

3 Ga onset of the supercontinent cycle: SCLM and crustal evidence

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A full understanding of the formation and evolution of the continents requires the use of constraints from both the subcontinental lithospheric mantle (SCLM) and crust. Significant differences exist globally between >3.2 Ga versus <3.0 Ga crust and SCLM. We propose that this time is a boundary between different geodynamic regimes on Earth and the start of the supercontinent (Wilson) cycle [1, 2].

To characterize the SCLM through time, we use geochronological studies of sulfide and silicate inclusions in diamonds from more than 20 kimberlites on 4 cratons [3]. Diamonds >3.2 Ga contain exclusively peridotitic (harzburgitic) silicate and sulfide inclusions whereas diamonds <3.0 Ga contain predominantly eclogitic silicate and sulfide inclusions. Similarly, >3.0 Ga kimberlite-borne eclogite xenoliths are largely absent in the SCLM rock record, whereas they are common thereafter.

Archean crust also records major differences across the 3.0–3.2 Ga interval. Prior to 3.2 Ga, crust grew by vertical accretion over upwelling mantle in long-lived plateaux floored by extremely depleted residual harzburgitic SCLM or via slab melting and crustal imbrication over shallow subduction zones (e. g West Greenland) [4], whereas lateral accretion, allochthonous greenstone belt growth and calcalkaline magmatic products of mantle wedge melting emerge only after 3.2 Ga [5].

This temporal and geochemical change can perhaps best be explained as the result of a step-wise change in the tectonic style of the planet from rapid mantle convection, small plates, shallow subduction, and localized recycling >3.2 Ga, followed by large plates, steep subduction, and full upper mantle recycling <3.0 Ga. These geodynamic changes would have had profound effects on mantle depletion, crustal growth, and geochemical cycles.

[1] Shirey *et al.* (2010) *EOS Trans AGU* U33A-0009. [2] Van Kranendonk *et al.* (2010) *Precamb Res* **177**, 145–161.[3] Gurney *et al.* (2010) *Econ Geol* **153** 689–712.[4] Van Kranendonk (2011) *Am J Sci* **310**, 1187–1209.[5] Smithies *et al.* (2005) *Earth Planet Sci Lett* **231**, 221–237.