Localized metasomatism of Grenvillian marble leading to its melting,
Highway 5 near Old Chelsea, Quebec

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The recent (2009) opening of an extension of Autoroute 5 north of Old Chelsea, Quebec, has produced striking roadcuts over a length of 2 km, with a wide variety of rock types and a very complex and bewildering juxtaposition of igneous, metamorphic, and metasomatic assemblages of minerals. I describe exposures of “regional” white calcite, and also calcite of orange, pink, yellow, blue and green color. Based on exsolution of dolomite in pink calcite, temperature estimated 700°C and Pressure 7 kbar (25 km depth) in similar rocks in the Bancroft area and at Otter Lake and Age, is 1040 Ma (Ottawan Orogeny) based on phlogopite, ⁴⁰Ar/³⁹Ar method (Kretz 1980). The orange to pink calcite forms dikes with a selvage of tiny euhedral diopside crystals. Above the dikes are diffuse zones of fracture-controlled reddening of the gray gneiss, in which the original mineralogy is replaced by a K-feldspar-dominant “syenitic” material. The orange calcite in those dikes [δ¹³C ~ −1‰, δ¹⁸O ~ 16‰] is isotopically intermediate between the regionally developed white marble [δ¹³C ~ 3‰, δ¹⁸O ~ 24‰] and a typical mantle-derived carbonatite [δ¹³C ~ −5‰, δ¹⁸O ~ 6‰]. We contend that the regional marble was locally metasomatized by an alkaline fluid of mixed crust + mantle derivation, then melted. Upon crystallization, this carbonate melt gave off a strongly alkaline H₂O dominant fluid that converted the gneissic host-rock into a quartz-bearing syenitic composition. The occurrence seems to be a good example of melting of marble in the crust, i.e., a crustal carbonatite.