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INCLUSIONS IN DIAMONDS FROM UHPM TERRANES: A NEW CONSTRAINT FOR DEPTH OF SUBDUCTION AND EXHUMATION

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Diamond is the strongest mineral and is essentially inert in rocks, hence it resists chemical reaction with its host or included minerals. Therefore, it is the most reliable sampling container for transporting fluid and solid crystalline materials from depth within the Earth to its surface. Determination of depth from which subducted ultra-high pressure metasedimentary rocks may return back to the surface is crucial for understanding tectonic aspects of exhumation and mountain building due to continental collisions, global recycling or/and sequestration of H, C and K in deep Earth's mantle. Several years ago we applied an innovative focused ion beam (FIB) technique that allows cutting of small diamonds crystals *in situ* and preparation of high quality 400 Å thick foils to be studied by transmission electron microscopy (TEM). These studies revealed that diamonds from felsic gneisses of the Kokchetav massif, Kazakhstan contain a rich inclusion suite of Si-, Fe-, Ti- and Cr-oxides. However, no good electron diffraction patterns were obtained to verify their structure due to technical difficulties Because unit cell parameters of SiO_2 included in microdiamonds have not been known, such diamonds used to serve only as an indicator of a minimum pressure, ca. 4 GPa. Other methods applied to Kokchetav diamond-bearing rocks yielded: T= 700 °C, or 920 to 1250 °C, and P = 4 to ~9 GPa. Our recent research on diamonds from dolomitic marbles of Kokchetav massif established that these diamonds contain nanometric fluid pockets enveloping well-shaped $CaCO_3$ crystals. Fluid consists of O, C, H, Cl, S, Ca, Fe and K. Electron diffraction patterns obtained from $CaCO_3$ inclusions confirmed their aragonite structure. Both inclusions of $MgCO_3$ with a few content of Ca, and $CaCO_3$ inclusions were also found in diamonds from Kokchetav site. In frame of this research, we determine the lower boundary of aragonite stability field by reaction: $CaMg(CO_3)_2 = CaCO_3$(aragonite) + $MgCO_3$. This allows us to use available experimental data on studies of dolomite break down reaction with production of aragonite and magnesite to evaluate pressure at which diamond was crystallized. Taking into consideration all uncertainties existing between experimental data produced in different laboratories, we propose the most accurate evaluation of minimum pressure for Kokchetav diamond crystallization to be between ~7 to 9 GPa. This evaluation is based on assumption that temperature was determined correctly as 980 °C (minimum) and as 1250 °C (maximum) for diamond-grade dolomitic marbles. Our data provide more convincing evaluation that metasedimentary rocks of Kokchetav massif containing diamonds were subducted to the minimum depth ~210 - 220 km.