Preservation conditions of CLIPPIR diamonds in the earth’s mantle in a heterogeneous metal-sulphide-silicate medium (experimental modeling)

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The genesis of CLIPPIR diamonds (Cullinan-like, large, inclusion-poor, pure, irregular, and resorbed) have attracted much interest due to their possible crystallization from metal melt in deep horizons of the earth’s mantle. These diamonds usually show a pronounced resorption and irregular morphology. The present paper reports new experimental data on the dissolution of diamond crystals at high $P$–$T$ parameters in Fe–S melt containing large amounts of silicate components (5–20 wt%). The experiments were performed using a split-sphere multi-anvil apparatus (BARS) at a pressure of 4 GPa and a temperature of 1450 °C. The samples consisted of natural diamond crystals placed in mixtures of Fe, S, and kimberlite. Wide variations in dissolution rates of diamond crystals were obtained. The absence of diamond dissolution in a heterogeneous medium indicates that the amount of solid silicate phases present in metal melt plays a role in the preservation of diamonds. This study demonstrated how diamonds can be stored in natural environments due to the heterogeneity of the medium composition which could insulate diamonds from the metal-sulphide melt. The obtained results improve our understanding of processes that lead to preservation of CLIPPIR diamonds in the deep mantle.

Keywords: CLIPPIR diamond, High pressure, Metal melt, Experiment

INTRODUCTION

Most recently, the study of CLIPPIR diamonds has attracted much interest. This is mainly due to the specific association of inclusions in these diamonds such as cohenite (Fe,Ni)C3, Fe–Ni alloy, iron sulphide (pyrrhotite) with a small amount of accessory phases in the form of Fe-phosphate, and Cr–Fe-oxide, as well as Fe-oxide and silicate inclusions such as Cr-poor majoritic garnet, CaSi-perovskite, CaSiO3-walstromite, and CaSi2O5-titanite (Smith et al., 2016, 2017; Nestola, 2017).

It is assumed that the genesis of CLIPPIR diamonds is associated with subduction processes. When oxidised crustal material reaches the deep horizons of the earth’s mantle, the Fe–Ni phases and melts become stable (Rohrbach et al., 2007; Frost and McConnon, 2008; Stagno and Frost, 2010; Stagno et al., 2013). Carbon from the carbonate phases and CO2 captured by the subducted plate reduce to the elemental state and diamond crystallization in Fe-Ni melt ‘drops’ occur (Smith et al., 2016, 2017; Nestola, 2017).

According to Smith et al. (2016, 2017), the bulk composition of the metal-sulphide inclusions in CLIPPIR diamonds is Fe$_{0.61-0.75}$Ni$_{0.10-0.13}$C$_{0.15-0.20}$S$_{0.05-0.12}$. Therefore, it can be assumed that the crystallization environment of diamonds contained up to 6–7 wt% of sulphur. A melt with such sulphur content could be a diamond producing medium, which has been confirmed experimentally (Zhimulev et al., 2012). Additionally, it has a very high solubility of carbon (in the range of 2.5–5.5 wt%) at high pressures depending on the amount of Ni and S in the system (Zhang et al., 2018). In the case of a small content of sulphur in the Fe–S melt, $P$–$T$ parameters of diamond crystallization are the same as in a completely iron melt without sulphur (Zhimulev et al., 2016). With an increase in the amount of sulphur in the system (up to melt/S ~ 1), diamond formation is unlikely due to a significant decrease in carbon solubility (Zhang et al., 2015). Taking into account a high solubility of carbon in sulphur-poor melts and average carbon content in the mantle, diamonds could be preserved in the mantle only in silicate domains (Dasgupta, 2013).
One of the typomorphic features of CLIPPIR diamonds is their pronounced resorption, that is, they have experienced dissolution and the morphology of these diamonds is usually irregular (Bowen et al., 2009; Moore, 2009, 2014; Smith et al., 2016, 2017). Nevertheless, despite this resorption, the CLIPPIR-type diamond crystals survived in the deep mantle and were stored there for a long time.

Earlier we carried out experimental studies on the dissolution of diamonds in the Fe–S melt (S = 20 wt%) at 4 GPa and 1400 °C (Sonin et al., 2018). The final shape of the dissolved crystals corresponds to an octahedron with curved surfaces corresponding to trigon–triocatahedron and rhombododecahedron. The morphology of the crystals becomes much more complicated when silicate components are added to the metal–sulphide melt. As a result of the dissolution in such a heterogeneous environment, diamonds have acquired irregular shapes with the addition of only 5 wt% of kimberlite to the system. This was due to the partial covering of the diamond surface by silicate components, which blocks the contact between the surface of the diamond crystal and the metal melt (Chepurov et al., 2018). The estimated solubility of carbon in the iron melt with 20 wt% of sulphur content was near 1 wt%. The data obtained agrees with the values of diamond solubility determined by Zhang et al. (2018). The particular focus of the present paper is an experimental study of the dissolution of diamond crystals at high P–T parameters in Fe–S melt containing a large amount of silicate components (more than 5 wt%).

**EXPERIMENTAL**

The experiments were performed using a split–sphere multi-anvil apparatus (BARS) according to state assignment 0330–2016-0012 at a pressure of 4 GPa and a temperature of 1450 °C. The solid–phase high–pressure cell was made of ZrO₂, CaO, and MgO refractory oxides and had a cylindrical graphite heater with molybdenum current conductors in its center. The assembled cell was kept dried in a furnace at 120 °C. The experimental procedure was the same in all experiments: first, the pressure was generated at a rate of 0.1–0.2 GPa/min. The pressure in the cell was calibrated at room temperature with the reference substances Bi and PbSe (Decker et al. 1972; Chepurov et al., 1998; Turkin, 2003, 2004), and the pressure determination error for the experiments was ±0.25 GPa. Next, the sample was heated to the required temperature corresponded to that in the central zone of the heater. The temperature in the high–pressure cell was measured with a platinum–rhodium thermocouple (Pt/Rh 30/6) placed close to the sample. The temperature measurement error was ±25 °C. A correction for the pressure changes during further heating was made according to the known position of the graphite–diamond P–T coordinate equilibrium line (Day, 2012). Further details of the experimental procedure are described in (Zhimulev et al., 2012; Chepurov et al., 2018; Sonin et al., 2018).

The experiments were conducted in MgO ampoules using powdered (crushed and ground on a ball mill to <5 μm) and carefully mixed starting materials consisting of 99.98 wt% pure sulphur and metallic iron. The sample assembly is shown in Figure 1. The Udachnaya–East kimberlite (Yakutia, Russia) was used as a natural solvent. The chemical composition of the kimberlite is: SiO₂, 29.40 wt%; TiO₂, 1.26 wt%; Al₂O₃, 2.34 wt%; FeO + Fe₂O₃, 9.21 wt%; MnO, 0.15 wt%; MgO, 32.00 wt%; CaO, 8.78 wt%; Na₂O, 0.01 wt%; K₂O, 0.97 wt%; P₂O₅, 0.40 wt%; LOI, 15.60 wt%; CO₂, 7.60 wt%; for a total of 100.12 wt% (Chepurov et al., 2018).

One half of the etchant powder was placed into a specially cut cylindrical anvil and pressed. Then, diamond crystal was placed on top of the cylinder, in the center, and covered by the other half of the powder pressed in the same way. Thus, we obtained a cylinder of pressed starting mix with a diamond crystal in the center. The weight

**Figure 1.** Sketch drawing of assembly configuration used in the experiments. 1, High–pressure cell. 2, Electric contact. 3, Graphite heater. 4, Sample, consisting of Fe–S + silicate (kimberlite) mix and diamond crystal in its center. 5, Thermocouple. Color version is available online from https://doi.org/10.2465/jmps.190818.
of the etchant was 1200 mg. The content of the components in the solvent are given in Table 1.

Natural colorless transparent diamonds of octahedral habit from kimberlite of Yakutia were used for this study. These crystals are characterized as Ia-type diamonds in frames of the physical classification (Orlov, 1977). The initial and final (after the experiments) weight of the crystals are given in Table 1. The selected diamond crystals had several specific features. On one side of the D1 crystal near the edges, there were stepped surfaces and in the center of the face there was a triangular plate (Fig. 2a); all stepped surfaces were faceted with \{111\} planes. On one

| Run no.  | Solvent composition, wt% | Duration, min | Diamond crystal (initial weight, mg) | Crystal weight after run, mg | Weight loss, mg (%) |
|----------|--------------------------|---------------|--------------------------------------|----------------------------|---------------------|
| 4-16-17  | Fe (85) - S (15)          | 60            | D1 (14.56)                           | 10.33                      | 4.23 (29.05)        |
| 4-1-18   | Fe (60) - S (20) - Kimberlite (20) | 60            | D2 (7.18)                            | 7.18                       | 0 (0)               |
| 4-6-18   | Fe (70) - S (20) - Kimberlite (10) | 30            | D3 (6.47)                            | 6.47                       | 0 (0)               |
| 4-12-18  | Fe (70) - S (20) - Kimberlite (10) | 30            | D4 (7.36)                            | 7.36                       | 0 (0)               |
| 4-21-17a | Fe (60) - S (20) - Kimberlite (20) | 30            | Without diamond                      | -                          | -                   |
| 4-21-17b | Fe (75) - S (20) - Kimberlite (5) | 30            | Without diamond                      | -                          | -                   |

Figure 2. Optical photographs of diamond crystals before experiments. (a) Crystal D1. (b) Crystal D2. (c) Crystal D3. (d) Crystal D4.
of the faces of the D2 crystal, there was a large faceted cavern and a small diamond subindividually which was intergrown with the main crystal (Fig. 2b). On crystals D3 and D4, in addition to the octahedron faces, small surfaces of rhombododecahedron complicated with thin parallel striations were observed (Figs. 2c and 2d).

In order to determine the phase composition of the solvent after the experiment we produced two diamond-free samples (run 4–21–17) with different amounts of silicate additives: Fe (75 wt%)-S (20 wt%)-kimberlite (5 wt%) and Fe (60 wt%)-S (20 wt%)-kimberlite (20 wt%). These two samples were placed separately in the MgO ampoule.

After the experiments the samples were boiled in a mixture of HCl and HNO3 acids in order to dissolve the metal–sulphide components and to extract diamonds. Then, the diamond crystals were treated in a mix of 10% water solution of K2Cr2O7 and concentrated H2SO4, in the ratio of 1:3 at 80 °C for 1 h. After this procedure the surface of the diamond crystals was cleaned from graphite particles which are a common product during the metal quench. Note that the oxidation of graphite particles to carbon monoxide does not lead to oxidation of diamond itself, and this procedure is widely used (Bogatyreva et al., 1974). After the above described treatments, the diamond crystals were additionally cleaned in distilled water and dried at 120 °C.

Macro- and micromorphological features of the crystals were studied under an optical microscope (MBS–10) and scanning electron microscopes (MIRA3 TESCAN and 1540 XB Crossbeam, Carl Zeiss) in a secondary electron mode. The diamonds were weighed before and after the runs to a precision of ±0.02 mg.

**RESULTS**

No change was observed in diamond D2 after experiment with a kimberlite content of 20 wt% in the reaction mixture (Figs. 3b and 4a). There was also no change in the crystal weight. When the content of kimberlite was 10 wt%, the small negative trigons – triangular etching pits – reversely oriented relative to the contours of the octahedral faces appeared on the diamond crystal D3 (experiment 4–6–18, Table 1). In addition, faceted caverns were locally formed (Fig. 4c). In order to avoid this effect, a control experiment was carried out (4–12–18, Table 1) using a crystal D4 and kimberlite content of 10 wt% in the solvent. This repeated experiment did not lead to the formation of cavities on the diamond surface, although, as in the case with the crystal D3, small trigons appeared on the diamond faces (Fig. 3d). No changes in the weight of crystals D3 and D4 were detected within the weighting accuracy of the scales.

In contrast, in experiment 4–16–17 (Table 1), which was performed without adding kimberlite to the system, the diamond crystal D1 lost 29.05 wt% of its initial weight. The morphology of this crystal also changed dramatically (Fig. 3a). Extensive surface dissolution occurred corresponding to the forms of the trigon-trioktahedron and the rhombododecahedron (Fig. 5a). In contrast to the initial flat octahedron faces, newly formed dissolution surfaces appeared, which consisted of a coarse striation (layering) in the form of columns elongated parallel to the <110> direction (Fig. 5b). Thus, the morphology of the originally flat-faceted octahedron evolved into the form of a roughly sculpted octahedroid. The morphological evolution obtained is consistent with the results of our previous study (Sonin et al., 2018), which aimed for the dissolution of diamonds in Fe–S melt with a 20 wt% of sulphur.

SEM images of samples from the control experiment 4–21–17 (without diamond) are presented in Figure 6. Segregation of the metal–sulphide melt in the center of the samples is clearly visible (Fig. 6a). At the same time, under the influence of gravity due to their lower density, the silicate components accumulated at the periphery, mainly in the upper part (Fig. 7). This is particularly evident in the sample with the addition of 5 wt% of kimberlite.

The silicate component of the samples consisted of olivine grains present in the quenched Fe–FeS alloy (Fig. 6b). These grains of olivine are covered with thin rims of magnesiowüstite. The chemical compositions of olivine and magnesiowüstite are given in Tables 2 and 3. In addition, the samples contained numerous voids which represent bubbles of a fluid formed during experiments after melting of kimberlite components (Fig. 6c). The quenched alloy consisted of FeS and metallic iron (Fig. 6d).

**DISCUSSION**

The model of CLIPPIR diamond formation (Smith et al., 2016) suggests a source of carbon originating from the earth’s crust (Fig. 8). According to modern concepts, carbonates and CO2 are the best candidates (Dasgupta and Hirschmann, 2010). The phenomenon of carbonate reduction to carbides and graphite or diamond (depending on pressure) in the presence of metallic iron has been demonstrated experimentally (Chepurov et al., 2011; Palyanov et al., 2013; Martirosyan et al., 2016). This effect occurs due to decomposition of the carbonates at high P–T, followed by the reduction of CO2. It is important to add that a key point in the discussed model (Smith et al., 2016) is the formation of metal melt ‘drops’ in mantle rocks in which diamonds could grow. It is worth saying that the possibility of reducing metallic iron from the iron-containing silicates and oxides under conditions...
of low oxygen fugacity, followed by the formation of diamond in the same experiment, has already been confirmed experimentally (Chepurov et al., 1999).

Another problem that exists is the low mobility of the carbonate substance. Its mobility could significantly increase with the presence of H$_2$O, followed by appearance of H$_2$O + CO$_2$ fluid or hydrated carbonatitic melt (Poli, 2015). As for water, at present it is believed that H$_2$O reaches the deep mantle with nominally anhydrous minerals. At the same time, it should be considered that during the decomposition of water-containing minerals, some parts of the aqueous fluid do not degas, but could remain in rocks in the form of inclusions in the newly formed minerals and in the interstices between them. For example, such phenomenon was shown during the decomposition of serpentine (antigorite) under high P-T conditions (Chepurov et al., 2010). It is important to emphasize that although the main part of the released fluid is concentrated in the interstices, the amount of fluid phase preserved as inclusions in the newly formed solid phases (olivine and orthopyroxene) could reach 2.43 wt%, and the fraction of H$_2$O itself is up to 2.06 wt% (Chepurov et al., 2012).

Thus, the model of CLIPPIR diamond formation (Smith et al., 2016) was fundamentally confirmed by the experimental studies. First of all, this concerns the possibility of the formation of metal melt ‘drops’ in mantle due to the reduction of iron-containing minerals under the conditions of low oxygen fugacity. The second is the decomposition of carbonates (CO$_2$) to elemental carbon and the ability of carbon-containing fluids/melts to migrate...
through crystalline rocks. When the carbon-containing fluid enters the Fe (+S) melt and, accordingly, after the achievement of supersaturation of melt with carbon, diamond could begin to crystallize. In case of the interruption of carbon supply by the fluid and, accordingly, the deficiency of carbon in the Fe (+S) melt, diamond should start to dissolve (Fig. 8). Moreover, magnesiowüstite can be formed due to the interaction of olivine with an iron

Figure 4. SEM images of diamond crystals after dissolution experiments. (a) Crystal D2. (b) Crystal D3. (c) Part of crystal D3 with a newly formed faceted cavern. (d) Part of crystal D3 with newly formed small negative trigons (indicated by dark arrows). (e) Crystal D4. (f) Negative trigons on the face of crystal D4.
Figure 5. SEM images of diamond crystal D1 after dissolution experiments. (a) Whole view. (b) Enlarged view of the surface of crystal D1.

Figure 6. SEM images of samples after experiment no. 4-27-17. (a) Whole view (the top picture with 20 wt% of kimberlite, the bottom one with 5 wt% of kimberlite). (b) Olivine grains with a rim of magnesiowüstite (Mg-Ws), grey phase is Fe-FeS alloy. (c) Rounded bubbles in Fe-FeS alloy. (d) Fe(white)-FeS(grey) quenched alloy.
melt, and such was demonstrated experimentally (Bulatov et al., 2019). The authors obtained the crystallization of ferropericlase in the iron–olivine system in the presence of CaCO₃ and MgCO₃.

In the present study, the conditions for the preservation of diamonds were established. They are based on the experimental dissolution of natural diamond crystals in Fe–S melt in the presence of silicate components (5, 10, and 20 wt%). The obtained fundamental result evidences the influence of silicates on the process of dissolution of diamonds in the Fe–S melt, which is associated with the phenomenon of blocking the surface of diamonds by silicate minerals. The rate of dissolution of diamond depends on the amount of silicate phases in a heterogeneous system. When the content of silicate phases is more than 20 wt%, a complete blocking of diamonds by silicate substance occurs and, as a result, dissolution of diamond stops. Most likely, it is not necessary that the solid phases completely block the surface of the diamonds. Simply, the formation of a solid phase framework in metallic liquid will prevent the access of unsaturated with carbon Fe–S portions of melt to the diamonds. For example, in case of a drop of Fe–S melt with a diameter of 1 mm contacting the diamond crystal, and the density of the metal–sulphide melt (Nishida et al., 2011; Shimoyama et al., 2013), as well as carbon solubility (~ 1 wt%) in the melt containing 20 wt% S (Chepurov et al., 2018; Zhang et al., 2018), it can be expected that ~ 0.03 mg of diamond carbon will dissolve in such drop of Fe–S melt, and this value is within the accuracy of weighing the crystals. If the smaller Fe–S drop, for example of 0.1 mm in diameter, contact with diamond surface, only ~ 0.003 mg of carbon can dissolve in the metal. The presence of numerous small drops of metal in this system is demonstrated in Figure 7, which corresponds to the upper part of the sample with a 20 wt% kimberlite (after run 4–27–17), and where the intermediate zone consists of solid components of kimberlite floated upward during experiment and the small drops of solidified Fe–S melt.

At a content of 10 wt% of silicate phases, a local dissolution of diamond surfaces occurs with the appearance of faceted cavities and negative trigons. If the content of silicate phases in Fe–S melt is 5 wt%, diamond crystals with an irregular etched surface could form (Chepurov et al., 2018). The fluid phase that is present in this system as bubbles of various sizes (varying from 1 to 100 µm or larger) can influence the morphology of the diamonds through the appearance of disk-shape sculptures on the surface of the diamond crystals (Chepurov et al., 2018). In addition, these bubbles of the fluid phase also can block the surface of the diamond crystal from the melt, and their presence was demonstrated experimentally (Osorgin et

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**Table 2.** Representative analyses of olivine after experiment no. 4–21–17

| Sample (wt%) | 1(a)* | 2(a) | 3(a) | 4(a) | 5(a) | 6(b)** | 7(b) | 8(b) |
|-------------|-------|------|------|------|------|-------|------|------|
| SiO₂        | 40.43 | 40.37| 40.35| 40.86| 40.54| 41.35 | 39.47| 41.23|
| TiO₂        | 0     | 0    | 0    | 0    | 0    | 0     | 0    | 0    |
| Al₂O₃       | 0     | 0    | 0    | 0    | 0    | 0     | 0    | 0    |
| Cr₂O₃       | 0     | 0    | 0    | 0    | 0    | 0     | 0    | 0    |
| FeO         | 8.71  | 10.48| 11.73| 8.26 | 8.4  | 6.11  | 14.51| 5.13 |
| MnO         | 0     | 0    | 0    | 0    | 0    | 0     | 0    | 0    |
| MgO         | 49.55 | 48.95| 47.59| 50.88| 49.88| 52.47 | 45.15| 52.82|
| CaO         | 0.77  | 0.83 | 0.98 | 0    | 0.78 | 0.55  | 0    | 0.49 |
| Total       | 99.46 | 100.63| 100.65| 100.44| 99.61| 100.48| 99.15| 99.67|

* Addition of 20 wt% kimberlite.
** Addition of 5 wt% kimberlite.

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**Table 3.** Representative analyses of magnesiowüstite after experiment no. 4–21–17

| Sample (wt%) | 1(a)* | 2(a) | 3(a) | 4(b)** | 5(b) | 6(b) |
|-------------|-------|------|------|--------|------|------|
| SiO₂        | 0     | 0    | 0    | 0      | 0    | 0    |
| TiO₂        | 0     | 0    | 0    | 0      | 0    | 0    |
| Al₂O₃       | 0     | 0    | 0    | 0      | 0    | 0    |
| Cr₂O₃       | 0.34  | 0.31 | 0.19 | 0.38   | 0.27 | 0.30 |
| FeO         | 91.69 | 92.64| 91.31| 93.30  | 93.99| 92.27|
| MnO         | 0     | 0    | 0    | 0      | 0    | 0    |
| MgO         | 7.48  | 7.87 | 8.21 | 5.79   | 6.22 | 6.67 |
| CaO         | 0     | 0    | 0    | 0      | 0    | 0    |
| Total       | 99.51 | 100.76| 99.71| 99.47  | 100.48| 99.24|

* Addition of 20 wt% kimberlite.
** Addition of 5 wt% kimberlite.

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**Figure 7.** SEM image of upper part of the sample after the experiment 4–27–17. Note the presence of numerous small drops of metal which are not interconnected.
al., 1987), as well as observed in natural diamonds (Chepurov et al., 1994). It is important to note that the blocking of the surface of diamonds by silicate phases occurs mainly due to their floating as a result of significantly different densities between the silicates and the metal–sulphide melt. To be precise, the specific gravity of olivine and diamond are 3.27–3.37 and 3.47–3.55 g/cm³, correspondingly, and the experimentally determined density of the molten iron containing 3.5 wt% C is 7.37 g/cm³ at 4.3 GPa and 1430 °C (Shimoyama et al., 2013). It should be emphasized that with the addition of sulphur to the system the density of this melt decreases, and the experimentally determined FeS melt density reaches values of 4.72 g/cm³ (3.8 GPa, 1530 °C) and 4.63 g/cm³ (2.8 GPa, 1430 °C) (Nishida et al., 2011). As the sulphur content in the melt in our experiments was less than eutectic composition of the Fe–FeS system, the melt significantly exceeded the density of both olivine and diamond.

Thus, diamonds in the reduced earth’s mantle could be stored for a long time as surrounded by silicate–oxide minerals. This is due to the near absence of carbon solubility in solid silicate or oxide phases (Keppler et al., 2003; Shcheka et al., 2006), and experiments performed at high P–T parameters using mantle minerals extracted from kimberlite xenoliths, have confirmed the stability of diamonds in such media (Zhimulev et al., 2004). Also, it can be assumed that the solubility of carbon decreases upon dissolution of the silicate components in the Fe–S melt, but after the experiments we did not find a stable silicon impurity in iron and in FeS sulphide. Therefore, our assumption explaining the observed phenomenon seems more realistic.

This permanent situation changed dramatically when the diamonds were captured by kimberlite magmas which are fluid-saturated (H₂O + CO₂). Kimberlite melt enriched with H₂O is an aggressive medium with respect to diamond, which has been confirmed experimentally (Arima and Inoue, 1995; Sonin et al., 2004; Kozai and Arima, 2005; Khokhryakov and Pal’yanov, 2007; Arima and Kozai, 2008). During oxidation in fluid-saturated kimberlite magma, diamond crystals acquire the crystallographic form of a tetrahedrohedroid. This shape results after the sequence of dissolution of octahedron diamond crystals through ditrigonal etching layers in H₂O-containing silicate melt (Sonin et al., 1997). At the same time, diamond crystals such as octahedroids (roughly laminar octahedrons) are widely distributed in kimberlites. It is worth noting that diamonds of such shape were also obtained experimentally by dissolution in Fe–S melts under high pressure (Sonin et al., 2018). Therefore, the presence of such crystals in kimberlites can be explained by their conservation inside xenoliths, avoiding reaction with kimberlite as in the case of flat-faced diamond octahedrons (Orlov, 1977).
CONCLUSION
The experiments performed in the present study at high pressure and high temperature were aimed to dissolve diamonds in Fe-S melt in the presence of silicate material in an amount of more than 5 wt%. It was demonstrated that diamonds can be stored in such an environment due to the heterogeneity of the medium composition. This means that the presence of solid (refractory) silicate phases which float together with diamonds in a denser (more than 2–2.5 times) sulphur-containing metal melt could influence the preservation of diamond crystals from dissolution. As a result, the diamonds are blocked and surrounded by the silicate minerals which lead to the insulation of the diamonds from the metal–sulphide melt. Following the model of CLIPPIR diamond genesis (Smith et al., 2016, 2017; Nestola, 2017) the process discussed herein could contribute significantly to the preservation of diamonds in natural conditions.

ACKNOWLEDGMENTS
The authors thank two anonymous reviewers and editor Takaya Nagai for the comprehensive reviewing of the manuscript. Valeri Sonin thanks the Russian Science Foundation (grant no. 17-17-01154) for supporting experiments.

SUPPLEMENTARY MATERIAL
Color version of Figures 1 and 8 is available online from https://doi.org/10.2465/jmps.190818.

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Manuscript received August 18, 2019
Manuscript accepted January 6, 2020
Manuscript handled by Takaya Nagai