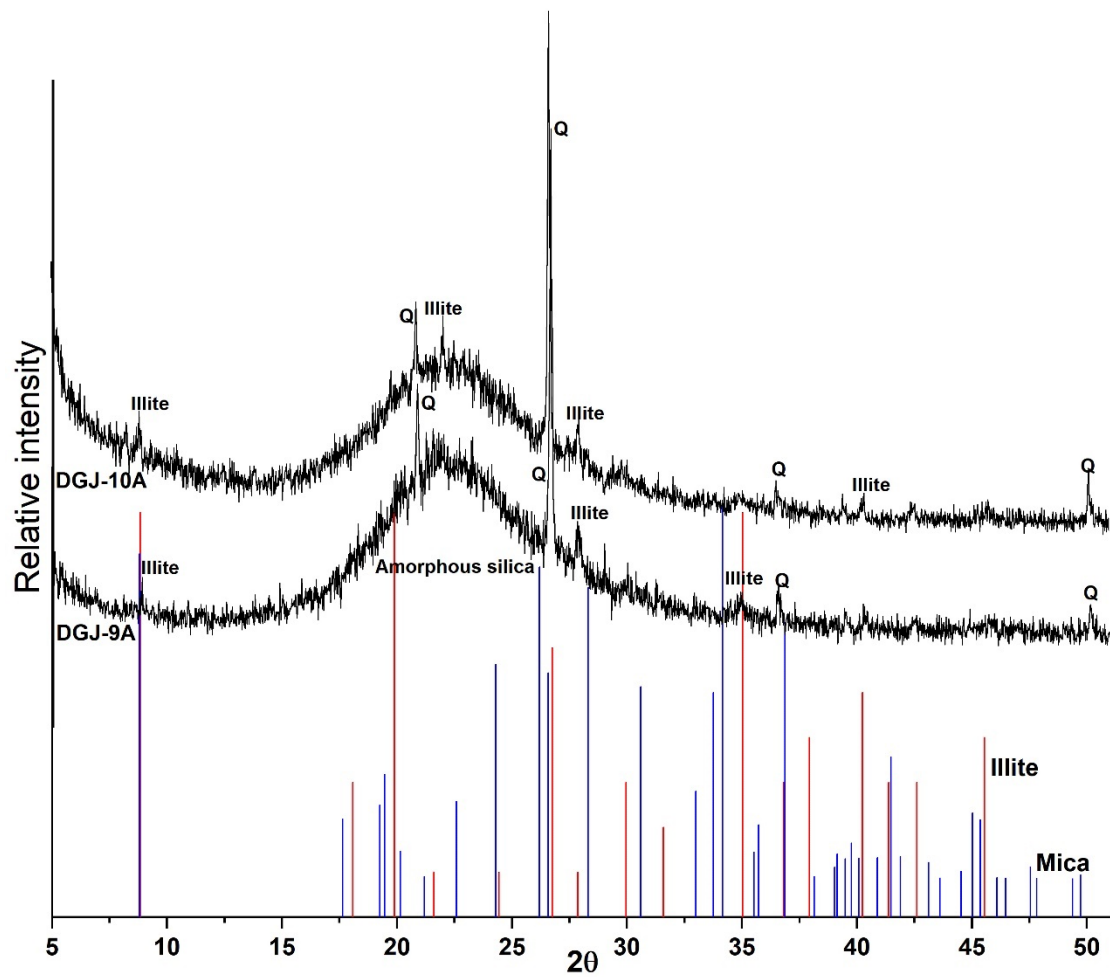
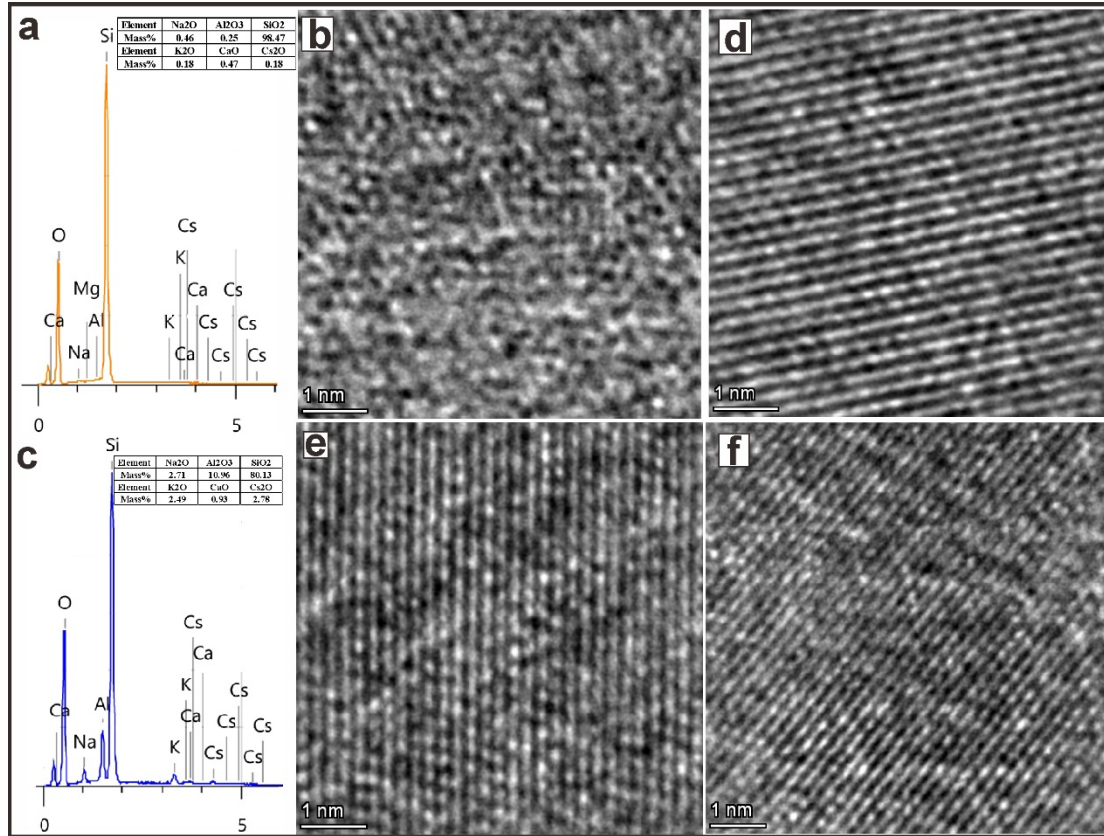


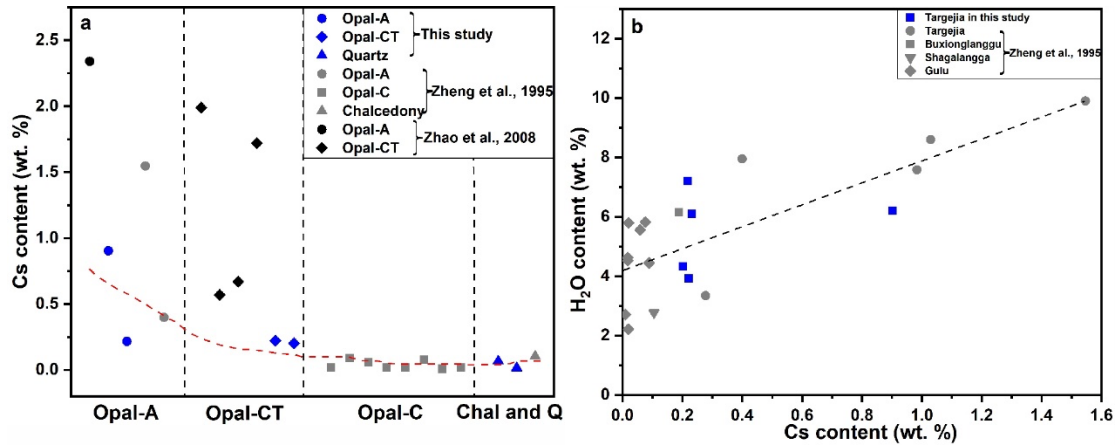
**Figure A1.** The hand specimen of opal-A and clay minerals at stage V (a), and opal-CT at stage IV and V (b). Scale bars are 1 cm.



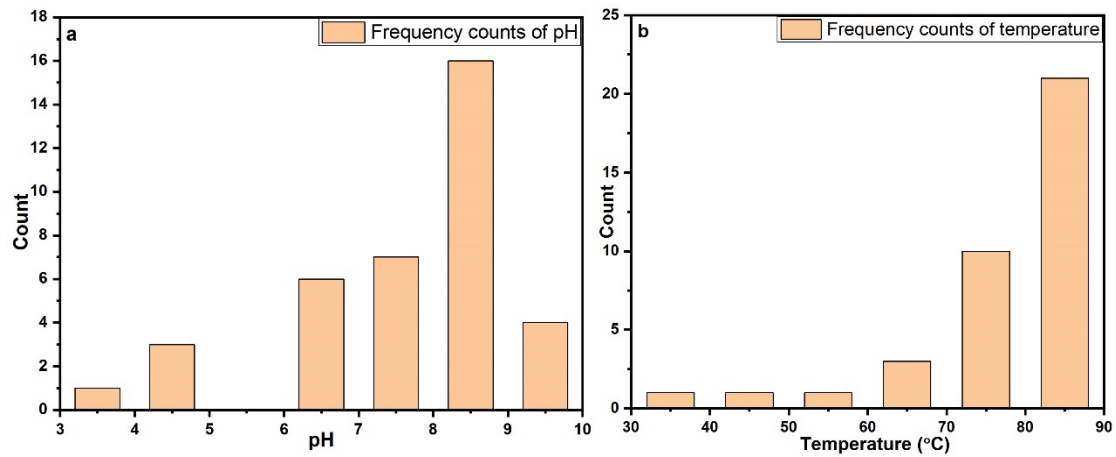
**Figure A2.** The XRD characteristics of mineralized ore (sample DGJ-9A and DGJ-10A) at stage V. Red lines and blue lines represent standard XRD patterns for illite and mica, respectively.



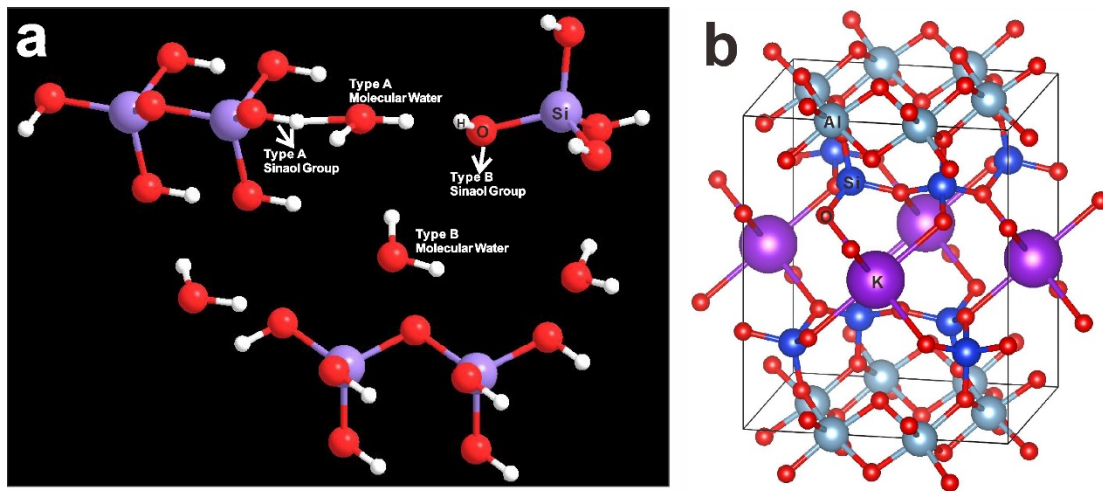
**Figure A3.** EDS analysis of sample DGJ-10A (a, c). Representative TEM images of Cs-bearing ore and barren ore. (b) sort of a chaotic nanoparticles crystallites in barren ore; (d, e, f) atomic resolution TEM revealed nanocrystalline material with 0.2 and 0.25 nm spacings in a direction.



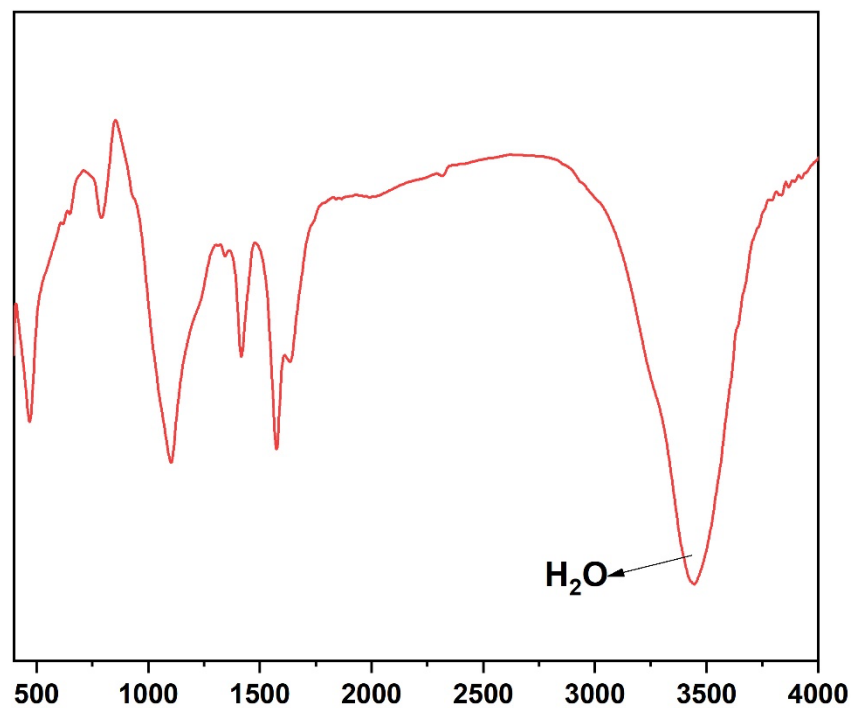
**Figure A4.** The relationship between Cs content with crystal degree (a) and H<sub>2</sub>O content (b).



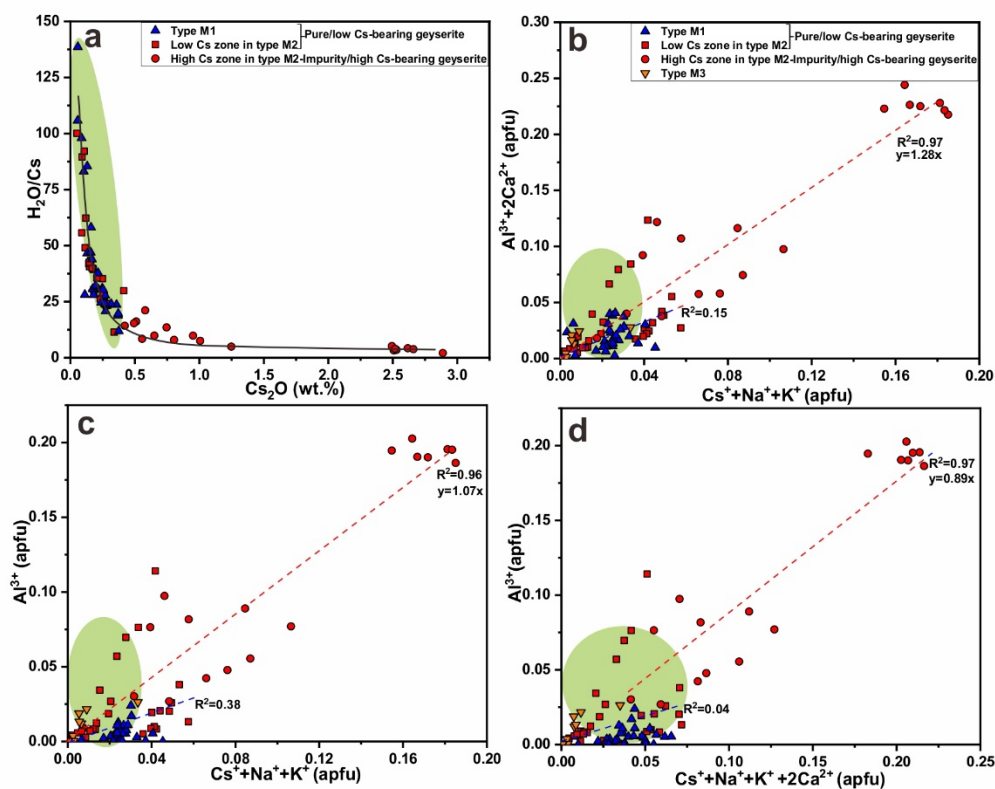
**Figure A5.** Frequency counts of pH and temperature of present activity geothermal fluids (Data from Zheng et al., 1995; Li et al., 2002; Wang et al., 2015; Yan et al., 2019).



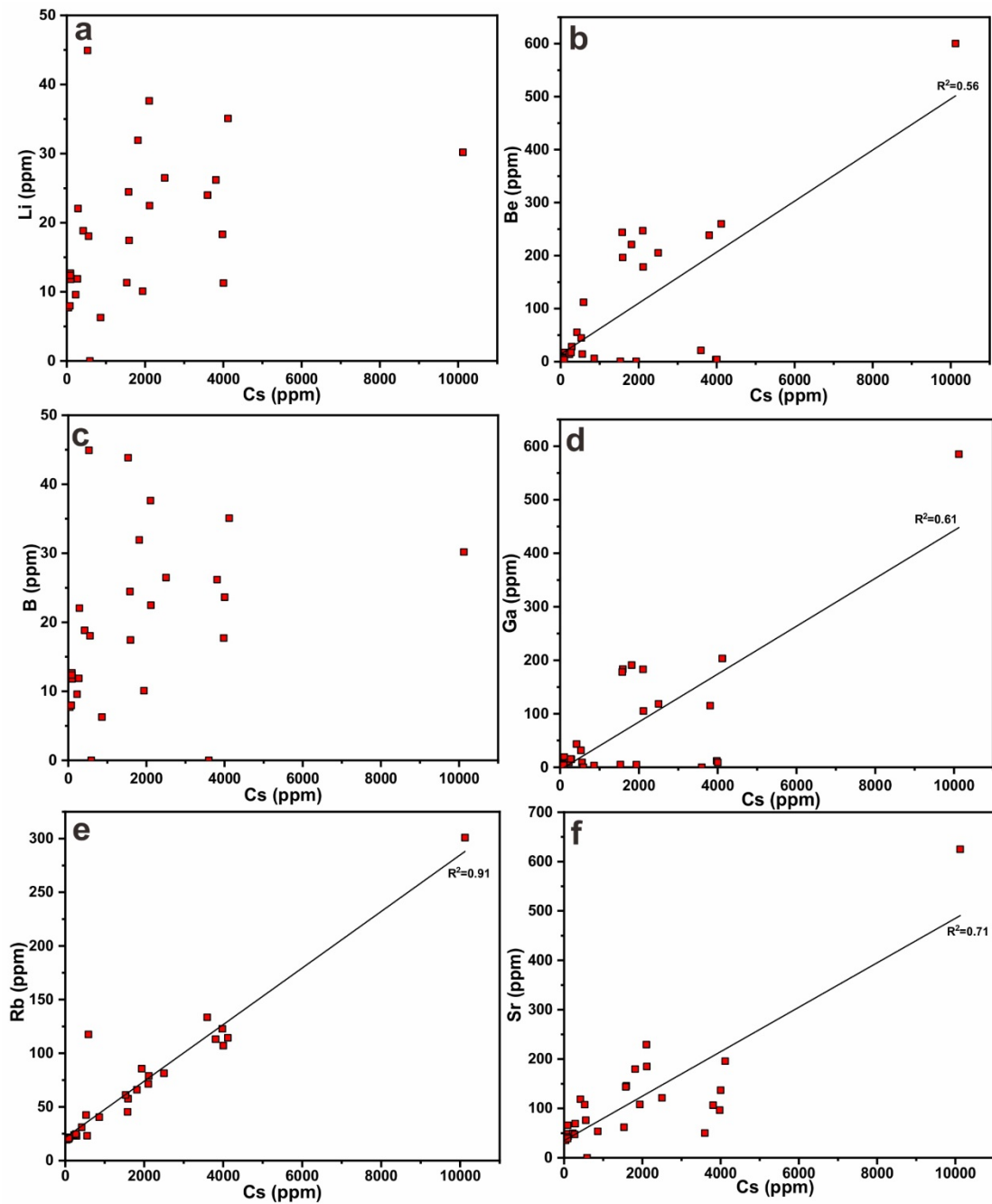
**Figure A6.** Schematic diagrams showing different forms in opal (Modified by Day and Jones, 2008) (a) and illite (b).



**Figure A7.** The spectrum pattern of Fourier transform infrared spectroscopy Schematic (FT-IR) of amorphous silica.



**Figure A8.** Correlation diagrams between Cs<sub>2</sub>O and H<sub>2</sub>O/Cs (a); relationship between positive charge and negative charge, Cs<sup>+</sup>+Na<sup>+</sup>+K<sup>+</sup> vs. Al<sup>3+</sup>+2Ca<sup>2+</sup> (b); Cs<sup>+</sup>+Na<sup>+</sup>+K<sup>+</sup> vs. Al<sup>3+</sup> (c); Cs<sup>+</sup>+Na<sup>+</sup>+K<sup>+</sup>+2Ca<sup>2+</sup> vs. Al<sup>3+</sup> (d); Black line in (a) represents the model of H<sub>2</sub>O and Cs. Blue line represents correlation in poor Cs-bearing ore. Red line represents correlation in high Cs zone in high Cs-bearing ore. Light green area represents the area of low Cs-bearing ore.



**Figure A9.** Correlation diagrams between Cs and Li (a), Be (b), B (c), Ga (d), Rb (e), Sr (f).