

Table 1. Spin-Hamiltonien parameters of radicals in natural glassy structure.

Radical	$g \pm 0.0003$	$A_1 \pm 0.5$ (G)	$A_2 \pm 0.5$ (G)	Radical	$g \pm 0.0003$	$A_1 \pm 0.5$ (G)	$A_2 \pm 0.5$ (G)
A	2.0111	-	-	E	2.0024	8.75	-
B	2.0002	-	-	F	2.0026	22	-
C	2.0018	27	-	G	2.0011	123.5	-
D	2.0022	22.5	-	H	2.0033	76	5.5

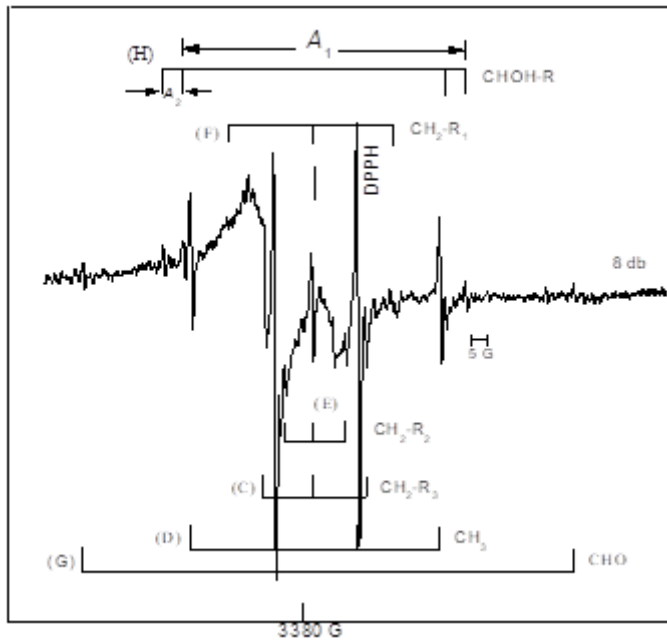


Figure 2. EPR spectrum of natural glassy taken at 433 K (microwave power = 8dB).

The quartet signal (D) shown in Fig. 2 and having a 1: 3: 3: 1 intensity distribution originates from three identical protons of the methyl ($\bullet \text{CH}_3$) group. The g and A values found for this signal is compatible with the literature for the $\bullet \text{CH}_3$ radical [13]. Although the methyl radical is extremely active and mobile, the silica continues its existence in the lattice since thousands of years.

The hyperfine structure splits of the two triplet signals (E and F) in Figure 2 are quite different from each other and the E and F signals have identical shape but belong to two different group in the structure. The g values calculated for these radicals are equal to each other. The difference of hyperfine structure splits is due to CH_2 radicals are linked to different inactive groups [15].

The doublet line indicated by "G" in Figure 2 with the hyperfine splitting of 123.5 G and $g = 2.0011$ belongs to \bullet HCO radical. The calculated values of g and A for this signal are in good agreement with the published data in the literature [16].

Another doublet with 27 G splitting and $g = 2.0018$ value appears in Fig. 2. This signal previously represented with a "C" belongs to the \bullet CH₂ radical attached to an inactive group R₃ [18-20]. "H" signal appearing as quadruple signals in the spectrum in Fig. 2 attributed to \bullet CHOH radical. The unpaired electron interacted with one of the non-identical protons and signaled the doublet. The unpaired electron then interacts with the beta proton to cause a doublet repeat splitting [20, 21].

4. Conclusions

The EPR spectra of the natural glassy structures containing silicon are given in Fig. 1 and Fig. 2. The g values of signals A and B in Figure 1 were determined as 2.0111 and 2.0002 and attributed to radicals O_3^- and CO_2^- , respectively. It was observed that the line widths and intensities of the EPR signals of these radicals changed with temperature. According to the g values of the EPR signals represented by C, D, E, F, G and H in Fig. 2, they can be assigned to the organic radicals \bullet CH₂, \bullet CH₃, CH₂-R₁, CH₂-R₂, \bullet HCO and \bullet CHOH respectively. The spin Hamiltonian parameters of each signal were found and are given in Table 1. The results show that this mineral was probably deposited by the Kızılırmak drifting along the active North Anatolian fault line.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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