**表1 大红柳滩地区二云母花岗岩及不同矿化程度伟晶岩中云母主量元素组成(wt.%)**

Table 1. Major element data of mica from two-mica granite and pegmatite in the Dahongliutan area (wt.%)

|  |  |  |
| --- | --- | --- |
|  | 二云母花岗岩 | 白云母-微斜长石伟晶岩 |
| 矿物 | Ms | Ms | Ms | Ms | Ms | Ms | Ms | Ms | Ms | Ms | Ms |
| 编号 | DN35-1-1 | DN35-1-4 | DN35-2-1 | DN35-2-2 | DN35-2-3 | DN5-1-1 | DN5-1-2 | DN5-1-3 | DN5-2-2 | DN5-2-3 | DN5-2-4 |
| SiO2 | 46.48  | 46.52  | 46.71  | 46.86  | 46.57  | 46.17  | 45.65  | 45.00  | 45.65  | 46.05  | 45.67  |
| TiO2 | 0.86  | 0.87  | 0.84  | 0.85  | 0.87  | 0.93  | 0.07  | 0.02  | 0.05  | 0.00  | 0.02  |
| Al2O3 | 35.54  | 35.37  | 35.36  | 34.70  | 35.10  | 35.19  | 36.24  | 36.84  | 36.75  | 36.79  | 36.36  |
| FeO | 1.42  | 1.39  | 1.40  | 1.58  | 1.50  | 1.41  | 1.51  | 1.20  | 1.22  | 1.22  | 1.57  |
| MnO | 0.06  | 0.04  | 0.04  | 0.05  | 0.04  | 0.03  | 0.08  | 0.04  | 0.00  | 0.04  | 0.07  |
| MgO | 0.60  | 0.59  | 0.60  | 0.70  | 0.73  | 0.51  | 0.12  | 0.09  | 0.11  | 0.00  | 0.14  |
| CaO | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.02  | 0.02  | 0.02  | 0.03  | 0.00  | 0.00  |
| Na2O | 0.37  | 0.31  | 0.36  | 0.45  | 0.49  | 0.36  | 0.53  | 0.33  | 0.38  | 0.61  | 0.30  |
| K2O | 10.13  | 10.04  | 10.03  | 10.16  | 9.95  | 10.31  | 9.95  | 9.84  | 10.12  | 9.74  | 9.92  |
| Rb2O | 0.08  | 0.00  | 0.00  | 0.06  | 0.07  | 0.00  | 0.36  | 0.73  | 0.70  | 0.78  | 0.95  |
| Cs2O | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.05  | 0.00  | 0.07  | 0.00  |
| F | 0.25  | 0.22  | 0.00  | 0.24  | 0.00  | 0.08  | 0.23  | 0.11  | 0.10  | 0.13  | 0.19  |
| Cl | 0.00  | 0.01  | 0.02  | 0.00  | 0.00  | 0.00  | 0.04  | 0.00  | 0.00  | 0.00  | 0.01  |
| O=F,Cl | 0.11  | 0.09  | 0.00  | 0.10  | 0.00  | 0.03  | 0.11  | 0.05  | 0.04  | 0.05  | 0.08  |
| Li2O\* | 0.06  | 0.05  | 0.00  | 0.06  | 0.00  | 0.01  | 0.06  | 0.02  | 0.02  | 0.03  | 0.04  |
| H2O\* | 4.41  | 4.41  | 4.52  | 4.41  | 4.52  | 4.46  | 4.35  | 4.40  | 4.44  | 4.44  | 4.38  |
| Total | 100.16  | 99.73  | 99.88  | 100.01  | 99.84  | 99.44  | 99.11  | 98.64  | 99.53  | 99.85  | 99.54  |
|  | 以24个阴离子为基础计算 |
| Si | 6.15  | 6.17  | 6.19  | 6.22  | 6.18  | 6.16  | 6.12  | 6.06  | 6.10  | 6.13  | 6.12  |
| AlⅣ | 1.85  | 1.83  | 1.81  | 1.78  | 1.82  | 1.84  | 1.88  | 1.94  | 1.90  | 1.87  | 1.88  |
| T-Site | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  |
| AlⅥ | 3.70  | 3.71  | 3.71  | 3.64  | 3.67  | 3.69  | 3.85  | 3.92  | 3.89  | 3.90  | 3.86  |
| Ti | 0.09  | 0.09  | 0.08  | 0.08  | 0.09  | 0.09  | 0.01  | 0.00  | 0.01  | 0.00  | 0.00  |
| Fe | 0.16  | 0.15  | 0.16  | 0.18  | 0.17  | 0.16  | 0.17  | 0.14  | 0.14  | 0.14  | 0.18  |
| Mn | 0.01  | 0.00  | 0.00  | 0.01  | 0.00  | 0.00  | 0.01  | 0.00  | 0.00  | 0.00  | 0.01  |
| Mg | 0.12  | 0.12  | 0.12  | 0.14  | 0.14  | 0.10  | 0.02  | 0.02  | 0.02  | 0.00  | 0.03  |
| Li\* | 0.03  | 0.03  | 0.00  | 0.03  | 0.00  | 0.01  | 0.03  | 0.01  | 0.01  | 0.02  | 0.02  |
| Y-Site | 4.10  | 4.10  | 4.07  | 4.08  | 4.08  | 4.06  | 4.09  | 4.09  | 4.06  | 4.05  | 4.09  |
| Ca | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Na | 0.09  | 0.08  | 0.09  | 0.12  | 0.13  | 0.09  | 0.14  | 0.09  | 0.10  | 0.16  | 0.08  |
| K | 1.71  | 1.70  | 1.70  | 1.72  | 1.68  | 1.75  | 1.70  | 1.69  | 1.72  | 1.65  | 1.69  |
| Rb | 0.01  | 0.00  | 0.00  | 0.01  | 0.01  | 0.00  | 0.03  | 0.06  | 0.06  | 0.07  | 0.08  |
| Cs | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| X-Site | 1.81  | 1.78  | 1.79  | 1.84  | 1.82  | 1.85  | 1.87  | 1.85  | 1.89  | 1.88  | 1.85  |
| F | 0.10  | 0.09  | 0.00  | 0.10  | 0.00  | 0.03  | 0.10  | 0.05  | 0.04  | 0.05  | 0.08  |
| Cl | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.01  | 0.00  | 0.00  | 0.00  | 0.00  |
| OH\* | 3.90  | 3.91  | 4.00  | 3.90  | 4.00  | 3.97  | 3.89  | 3.95  | 3.96  | 3.95  | 3.92  |
| Z-Site | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  |

**续表1**

Continued Table 1

|  |  |  |
| --- | --- | --- |
|   | 白云母-微斜长石伟晶岩 | 白云母-钠长石-锂辉石伟晶岩 |
| 矿物 | Ms | Ms | Ms | Ms | Ms | Ms | Zwd | Ms | Ms | Ms | Ms | Ms |
| 编号 | DN32-1-1 | DN32-1-2 | DN32-2-7 | DN32-2-8 | DN32-2-9 | DN15-1-1 | DN15-1-4 | DN15-1-5 | DN15-2-1 | DN15-2-2 | DN15-2-3 | DN15-2-5 |
| SiO2 | 45.47  | 45.08  | 45.87  | 45.92  | 45.81  | 46.44  | 52.19  | 46.35  | 46.53  | 46.14  | 45.34  | 46.33  |
| TiO2 | 0.00  | 0.00  | 0.08  | 0.11  | 0.04  | 0.03  | 0.00  | 0.00  | 0.10  | 0.11  | 0.10  | 0.09  |
| Al2O3 | 37.67  | 37.00  | 36.74  | 36.63  | 37.35  | 36.44  | 21.25  | 36.55  | 36.59  | 37.12  | 37.46  | 36.95  |
| FeO | 0.94  | 1.00  | 1.08  | 1.09  | 1.04  | 1.62  | 5.36  | 1.74  | 1.35  | 1.34  | 1.25  | 1.27  |
| MnO | 0.00  | 0.02  | 0.06  | 0.00  | 0.03  | 0.06  | 0.28  | 0.08  | 0.05  | 0.05  | 0.05  | 0.07  |
| MgO | 0.22  | 0.28  | 0.31  | 0.40  | 0.24  | 0.06  | 0.14  | 0.05  | 0.06  | 0.07  | 0.03  | 0.05  |
| CaO | 0.00  | 0.02  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Na2O | 0.39  | 0.42  | 0.29  | 0.34  | 0.48  | 0.39  | 0.07  | 0.44  | 0.27  | 0.26  | 0.31  | 0.28  |
| K2O | 10.25  | 10.44  | 10.04  | 10.16  | 9.98  | 10.04  | 10.47  | 10.28  | 10.00  | 10.12  | 10.34  | 9.50  |
| Rb2O | 0.09  | 0.11  | 0.00  | 0.11  | 0.14  | 0.42  | 1.07  | 0.41  | 0.41  | 0.45  | 0.44  | 0.49  |
| Cs2O | 0.00  | 0.04  | 0.00  | 0.00  | 0.00  | 0.04  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| F | 0.00  | 0.00  | 0.11  | 0.11  | 0.14  | 0.27  | 6.17  | 0.18  | 0.09  | bdl | 0.12  | 0.16  |
| Cl | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.02  | 0.04  |
| O=F,Cl | 0.00  | 0.00  | 0.05  | 0.05  | 0.06  | 0.11  | 2.60  | 0.08  | 0.04  | 0.00  | 0.06  | 0.08  |
| Li2O\* | 0.00  | 0.00  | 0.02  | 0.02  | 0.03  | 0.07  | 4.39  | 0.04  | 0.02  | 0.00  | 0.02  | 0.03  |
| H2O\* | 4.51  | 4.47  | 4.44  | 4.45  | 4.46  | 4.39  | 1.51  | 4.44  | 4.48  | 4.53  | 4.44  | 4.43  |
| Total | 99.54  | 98.88  | 99.00  | 99.29  | 99.68  | 99.08  | 98.06  | 99.80  | 99.22  | 99.32  | 97.79  | 100.24  |
|  | 以24个阴离子为基础计算 |
| Si | 6.04  | 6.05  | 6.12  | 6.12  | 6.07  | 6.16  | 7.05  | 6.14  | 6.17  | 6.11  | 6.04  | 6.14  |
| AlⅣ | 1.96  | 1.95  | 1.88  | 1.88  | 1.93  | 1.84  | 0.95  | 1.86  | 1.83  | 1.89  | 1.96  | 1.86  |
| T-Site | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  |
| AlⅥ | 3.94  | 3.90  | 3.89  | 3.87  | 3.91  | 3.85  | 2.44  | 3.84  | 3.88  | 3.90  | 3.91  | 3.92  |
| Ti | 0.00  | 0.00  | 0.01  | 0.01  | 0.00  | 0.00  | 0.00  | 0.00  | 0.01  | 0.01  | 0.01  | 0.01  |
| Fe | 0.10  | 0.11  | 0.12  | 0.12  | 0.12  | 0.18  | 0.61  | 0.19  | 0.15  | 0.15  | 0.14  | 0.14  |
| Mn | 0.00  | 0.00  | 0.01  | 0.00  | 0.00  | 0.01  | 0.03  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  |
| Mg | 0.04  | 0.06  | 0.06  | 0.08  | 0.05  | 0.01  | 0.03  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  |
| Li\* | 0.00  | 0.00  | 0.01  | 0.01  | 0.02  | 0.04  | 2.39  | 0.02  | 0.01  | 0.00  | 0.01  | 0.02  |
| Y-Site | 4.09  | 4.07  | 4.10  | 4.09  | 4.10  | 4.09  | 5.49  | 4.08  | 4.07  | 4.08  | 4.08  | 4.11  |
| Ca | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Na | 0.10  | 0.11  | 0.07  | 0.09  | 0.12  | 0.10  | 0.02  | 0.11  | 0.07  | 0.07  | 0.08  | 0.07  |
| K | 1.74  | 1.79  | 1.71  | 1.73  | 1.69  | 1.70  | 1.80  | 1.74  | 1.69  | 1.71  | 1.76  | 1.61  |
| Rb | 0.01  | 0.01  | 0.00  | 0.01  | 0.01  | 0.04  | 0.09  | 0.03  | 0.03  | 0.04  | 0.04  | 0.04  |
| Cs | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| X-Site | 1.85  | 1.91  | 1.78  | 1.82  | 1.82  | 1.84  | 1.92  | 1.88  | 1.80  | 1.81  | 1.87  | 1.72  |
| F | 0.00  | 0.00  | 0.05  | 0.05  | 0.06  | 0.11  | 2.64  | 0.08  | 0.04  | 0.00  | 0.05  | 0.07  |
| Cl | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.01  |
| OH\* | 4.00  | 4.00  | 3.95  | 3.95  | 3.94  | 3.89  | 1.36  | 3.92  | 3.96  | 4.00  | 3.94  | 3.92  |
| Z-Site | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  |

**续表1**

Continued Table 1

|  |  |
| --- | --- |
|  | 白云母-钠长石-锂辉石伟晶岩 |
| 矿物 | Zwd | Lpd | Zwd | Lpd | Lpd | Ms | Ms | Li-phg | Ms | Ms | Ms | Ms | Ms |
| 编号 | DN15-1-3 | AK3-1-7 | AK3-1-11 | AK3-1-8 | AK3-1-9 | AK3-2-5 | DN13-1-2 | DN13-1-3 | DN13-2-1 | DN13-2-2 | DN13-3-1 | DN13-3-5 | DN13-3-7 |
| SiO2 | 52.03  | 52.81  | 52.27  | 52.38  | 52.87  | 45.72  | 46.58  | 49.48  | 46.03  | 46.32  | 45.60  | 45.39  | 49.12  |
| TiO2 | 0.00  | 0.05  | 0.02  | 0.04  | 0.02  | 0.00  | 0.07  | 0.05  | 0.09  | 0.06  | 0.03  | 0.07  | 0.06  |
| Al2O3 | 23.39  | 21.08  | 21.19  | 21.53  | 21.85  | 37.56  | 35.33  | 26.46  | 37.28  | 35.88  | 37.23  | 36.07  | 32.39  |
| FeO | 3.65  | 3.83  | 4.57  | 4.21  | 3.64  | 0.83  | 1.17  | 3.99  | 0.86  | 1.07  | 0.90  | 0.81  | 2.72  |
| MnO | 0.25  | 0.28  | 0.41  | 0.26  | 0.16  | 0.00  | 0.03  | 0.18  | 0.04  | 0.04  | 0.03  | 0.02  | 0.09  |
| MgO | 0.04  | 0.06  | 0.06  | 0.04  | 0.07  | 0.12  | 0.03  | 0.09  | 0.03  | 0.03  | 0.00  | 0.03  | 0.04  |
| CaO | 0.00  | 0.02  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.02  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Na2O | 0.11  | 0.06  | 0.03  | 0.09  | 0.09  | 0.39  | 0.12  | 0.06  | 0.53  | 0.20  | 0.30  | 0.50  | 0.10  |
| K2O | 10.53  | 10.57  | 10.40  | 10.57  | 10.68  | 10.00  | 10.61  | 10.15  | 9.82  | 10.48  | 10.22  | 10.01  | 10.07  |
| Rb2O | 1.13  | 1.28  | 1.32  | 1.26  | 1.20  | 0.61  | 0.51  | 0.90  | 0.53  | 0.54  | 0.52  | 0.43  | 0.62  |
| Cs2O | 0.11  | 0.13  | 0.12  | 0.17  | 0.11  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| F | 5.60  | 6.45  | 6.15  | 6.47  | 6.30  | 0.00  | 0.40  | 3.36  | 0.20  | 0.33  | 0.00  | 0.11  | 1.04  |
| Cl | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| O=F,Cl | 2.36  | 2.72  | 2.59  | 2.72  | 2.65  | 0.00  | 0.17  | 1.41  | 0.08  | 0.14  | 0.00  | 0.05  | 0.44  |
| Li2O\* | 3.86  | 4.66  | 4.38  | 4.68  | 4.52  | 0.00  | 0.12  | 1.96  | 0.05  | 0.09  | 0.00  | 0.02  | 0.41  |
| H2O\* | 1.81  | 1.39  | 1.51  | 1.39  | 1.49  | 4.52  | 4.28  | 2.77  | 4.43  | 4.32  | 4.49  | 4.38  | 4.02  |
| Total | 100.15  | 99.95  | 99.84  | 100.36  | 100.34  | 99.75  | 99.08  | 98.06  | 99.80  | 99.22  | 99.32  | 97.79  | 100.24  |
|  | 以24个阴离子为基础计算 |
| Si | 6.99  | 7.12  | 7.09  | 7.05  | 7.09  | 6.07  | 6.25  | 6.79  | 6.10  | 6.20  | 6.09  | 6.15  | 6.53  |
| AlⅣ | 1.01  | 0.88  | 0.91  | 0.95  | 0.91  | 1.93  | 1.75  | 1.21  | 1.90  | 1.80  | 1.91  | 1.85  | 1.47  |
| T-Site | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  | 8.00  |
| AlⅥ | 2.70  | 2.47  | 2.48  | 2.47  | 2.54  | 3.95  | 3.83  | 3.08  | 3.93  | 3.86  | 3.94  | 3.91  | 3.60  |
| Ti | 0.00  | 0.01  | 0.00  | 0.00  | 0.00  | 0.00  | 0.01  | 0.01  | 0.01  | 0.01  | 0.00  | 0.01  | 0.01  |
| Fe | 0.41  | 0.43  | 0.52  | 0.47  | 0.41  | 0.09  | 0.13  | 0.46  | 0.10  | 0.12  | 0.10  | 0.09  | 0.30  |
| Mn | 0.03  | 0.03  | 0.05  | 0.03  | 0.02  | 0.00  | 0.00  | 0.02  | 0.00  | 0.00  | 0.00  | 0.00  | 0.01  |
| Mg | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  | 0.02  | 0.01  | 0.02  | 0.01  | 0.01  | 0.00  | 0.01  | 0.01  |
| Li\* | 2.09  | 2.53  | 2.39  | 2.53  | 2.44  | 0.00  | 0.06  | 1.08  | 0.03  | 0.05  | 0.00  | 0.01  | 0.22  |
| Y-Site | 5.23  | 5.48  | 5.45  | 5.52  | 5.42  | 4.07  | 4.04  | 4.66  | 4.07  | 4.04  | 4.05  | 4.02  | 4.15  |
| Ca | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Na | 0.03  | 0.02  | 0.01  | 0.02  | 0.02  | 0.10  | 0.03  | 0.02  | 0.14  | 0.05  | 0.08  | 0.13  | 0.03  |
| K | 1.80  | 1.82  | 1.80  | 1.82  | 1.83  | 1.69  | 1.81  | 1.78  | 1.66  | 1.79  | 1.74  | 1.73  | 1.71  |
| Rb | 0.10  | 0.11  | 0.12  | 0.11  | 0.10  | 0.05  | 0.04  | 0.08  | 0.05  | 0.05  | 0.04  | 0.04  | 0.05  |
| Cs | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| X-Site | 1.94  | 1.96  | 1.93  | 1.96  | 1.96  | 1.85  | 1.89  | 1.88  | 1.84  | 1.89  | 1.86  | 1.90  | 1.79  |
| F | 2.38  | 2.75  | 2.64  | 2.76  | 2.67  | 0.00  | 0.17  | 1.46  | 0.08  | 0.14  | 0.00  | 0.05  | 0.44  |
| Cl | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| OH\* | 1.62  | 1.25  | 1.36  | 1.24  | 1.33  | 4.00  | 3.83  | 2.54  | 3.92  | 3.86  | 4.00  | 3.95  | 3.56  |
| Z-Site | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  |

注：Ms-白云母；Li-Phg-富锂多硅白云母；Zwd-铁锂云母；Lpd-锂云母；带\*的元素含量根据相关计算得到。

**表2 大红柳滩地区二云母花岗岩及不同矿化程度伟晶岩中电气石主量元素数据（wt.%）**

Table 2. Major element data of tourmaline from two-mica granite and pegmatite in the Dahongliutan area (wt.%)

|  |  |
| --- | --- |
|  | 二云母花岗岩 |
| 矿物 | Schorl | Schorl | Schorl | Schorl | Schorl | Schorl | Schorl | Schorl | Schorl | Schorl | Schorl | Schorl |
| 编号 | DN35-3-1 | DN35-3-2 | DN35-3-3 | DN35-3-4 | DN35-4-11 | DN35-4-10 | DN35-4-9 | DN35-4-8 | DN35-5-1 | DN35-5-2 | DN35-5-3 | DN35-5-4 |
| SiO2 | 34.81  | 35.42  | 35.38  | 34.69  | 34.79  | 35.33  | 35.35  | 35.52  | 35.32  | 34.96  | 35.23  | 35.11  |
| TiO2 | 0.82  | 0.88  | 0.76  | 0.91  | 0.84  | 0.88  | 0.69  | 0.62  | 0.56  | 0.70  | 0.74  | 0.78  |
| Al2O3 | 33.57  | 33.66  | 33.22  | 33.70  | 34.02  | 33.64  | 32.92  | 33.71  | 33.18  | 33.17  | 33.43  | 33.13  |
| V2O3 | 0.00  | 0.00  | 0.00  | 0.03  | 0.03  | 0.00  | 0.02  | 0.00  | 0.00  | 0.00  | 0.02  | 0.00  |
| FeO | 9.44  | 9.72  | 9.42  | 9.20  | 9.33  | 9.31  | 9.33  | 9.32  | 9.25  | 9.32  | 9.51  | 9.33  |
| MgO | 4.21  | 4.43  | 4.46  | 4.22  | 4.34  | 4.42  | 4.46  | 4.66  | 4.59  | 4.61  | 4.62  | 4.45  |
| CaO | 0.24  | 0.26  | 0.29  | 0.30  | 0.28  | 0.27  | 0.26  | 0.29  | 0.27  | 0.29  | 0.25  | 0.24  |
| MnO | 0.11  | 0.13  | 0.11  | 0.11  | 0.09  | 0.10  | 0.11  | 0.14  | 0.10  | 0.10  | 0.09  | 0.08  |
| Na2O | 2.07  | 2.11  | 2.19  | 2.18  | 2.27  | 2.20  | 2.11  | 2.02  | 2.18  | 2.24  | 2.11  | 2.26  |
| K2O | 0.04  | 0.05  | 0.03  | 0.03  | 0.05  | 0.03  | 0.06  | 0.04  | 0.02  | 0.06  | 0.06  | 0.03  |
| F | 0.00  | 0.19  | 0.11  | 0.00  | 0.00  | 0.00  | 0.15  | 0.00  | 0.15  | 0.12  | 0.19  | 0.00  |
| H2O\* | 3.60  | 3.56  | 3.58  | 3.61  | 3.63  | 3.64  | 3.53  | 3.65  | 3.54  | 3.55  | 3.54  | 3.61  |
| B2O3\* | 10.44  | 10.59  | 10.51  | 10.46  | 10.53  | 10.56  | 10.45  | 10.57  | 10.48  | 10.45  | 10.52  | 10.46  |
| Li2O\* | 0.21  | 0.20  | 0.25  | 0.27  | 0.24  | 0.26  | 0.25  | 0.17  | 0.22  | 0.21  | 0.17  | 0.26  |
| O=F | 0.00  | 0.08  | 0.05  | 0.00  | 0.00  | 0.00  | 0.06  | 0.00  | 0.06  | 0.05  | 0.08  | 0.00  |
| Total\* | 99.57  | 101.12  | 100.27  | 99.70  | 100.44  | 100.65  | 99.64  | 100.72  | 99.80  | 99.73  | 100.40  | 99.73  |
|  | 基于31个氧原子计算 |
| T: Si | 5.80  | 5.81  | 5.85  | 5.77  | 5.74  | 5.81  | 5.88  | 5.84  | 5.86  | 5.81  | 5.82  | 5.83  |
| Al | 0.21  | 0.19  | 0.15  | 0.24  | 0.26  | 0.19  | 0.12  | 0.16  | 0.14  | 0.19  | 0.18  | 0.17  |
| B | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  |
| Z: Al | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  |
| Mg | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Fe3+ | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Y: Al | 0.38  | 0.33  | 0.32  | 0.37  | 0.37  | 0.34  | 0.33  | 0.37  | 0.35  | 0.32  | 0.33  | 0.32  |
| Ti | 0.10  | 0.11  | 0.09  | 0.11  | 0.10  | 0.11  | 0.09  | 0.08  | 0.07  | 0.09  | 0.09  | 0.10  |
| V | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Fe3+ | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Mg | 1.05  | 1.08  | 1.10  | 1.05  | 1.07  | 1.08  | 1.11  | 1.14  | 1.14  | 1.14  | 1.14  | 1.10  |
| Mn | 0.02  | 0.02  | 0.02  | 0.02  | 0.01  | 0.01  | 0.02  | 0.02  | 0.01  | 0.01  | 0.01  | 0.01  |
| Fe2+ | 1.31  | 1.33  | 1.30  | 1.28  | 1.29  | 1.28  | 1.30  | 1.28  | 1.28  | 1.30  | 1.31  | 1.30  |
| Li\* | 0.14  | 0.13  | 0.17  | 0.18  | 0.16  | 0.17  | 0.17  | 0.11  | 0.15  | 0.14  | 0.11  | 0.17  |
| ΣY | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  |
| X: Ca | 0.04  | 0.05  | 0.05  | 0.05  | 0.05  | 0.05  | 0.05  | 0.05  | 0.05  | 0.05  | 0.04  | 0.04  |
| Na | 0.67  | 0.67  | 0.70  | 0.70  | 0.73  | 0.70  | 0.68  | 0.64  | 0.70  | 0.72  | 0.68  | 0.73  |
| K | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  | 0.00  | 0.01  | 0.01  | 0.01  |
| X□ | 0.28  | 0.27  | 0.24  | 0.24  | 0.21  | 0.24  | 0.26  | 0.30  | 0.25  | 0.21  | 0.27  | 0.22  |
| OH | 4.00  | 3.90  | 3.94  | 4.00  | 4.00  | 4.00  | 3.92  | 4.00  | 3.92  | 3.94  | 3.90  | 4.00  |

**续表2**

Continued Table 2

|  |  |  |
| --- | --- | --- |
|  | 白云母-微斜长石伟晶岩 | 白云母-钠长石-锂辉石伟晶岩 |
|  矿物 | Schorl | Schorl | Schorl | Schorl | Schorl | Elbaite | Elbaite | Elbaite | Elbaite | Elbaite | Elbaite | Elbaite | Elbaite |
|  编号 | DN5-3-1 | DN5-3-2 | DN5-3-7 | DN5-4-5 | DN5-4-6 | AK3-2 | AK3-3 | AK4-5 | AK4-6 | AK4-9 | AK5-11 | AK5-12 | AK5-13 |
| SiO2 | 34.65  | 33.68  | 34.35  | 33.82  | 33.60  | 35.63  | 34.82  | 34.79  | 35.11  | 35.47  | 35.27  | 35.56  | 35.72  |
| TiO2 | 0.21  | 0.23  | 0.16  | 0.23  | 0.25  | 0.17  | 0.16  | 0.11  | 0.13  | 0.13  | 0.17  | 0.24  | 0.19  |
| Al2O3 | 35.51  | 36.44  | 36.36  | 36.15  | 36.80  | 36.65  | 36.91  | 37.17  | 37.10  | 37.05  | 37.40  | 36.85  | 37.47  |
| V2O3 | 0.00  | 0.03  | 0.00  | 0.00  | 0.00  | 0.20  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.04  | 0.02  |
| FeO | 11.36  | 11.43  | 11.67  | 11.58  | 11.77  | 8.11  | 8.25  | 7.66  | 7.82  | 8.22  | 8.11  | 8.38  | 8.49  |
| MgO | 0.43  | 0.40  | 0.47  | 0.43  | 0.47  | 0.04  | 0.04  | 0.05  | 0.05  | 0.02  | 0.02  | 0.04  | 0.03  |
| CaO | 0.12  | 0.12  | 0.08  | 0.06  | 0.13  | 0.07  | 0.12  | 0.10  | 0.10  | 0.09  | 0.11  | 0.09  | 0.06  |
| MnO | 0.21  | 0.29  | 0.24  | 0.24  | 0.25  | 0.29  | 0.32  | 0.29  | 0.33  | 0.35  | 0.37  | 0.31  | 0.34  |
| Na2O | 2.13  | 2.18  | 1.89  | 2.05  | 2.04  | 2.60  | 2.60  | 2.72  | 2.58  | 2.65  | 2.58  | 2.69  | 2.57  |
| K2O | 0.04  | 0.03  | 0.03  | 0.03  | 0.03  | 0.05  | 0.06  | 0.04  | 0.00  | 0.00  | 0.02  | 0.02  | 0.02  |
| F | 0.42  | 0.34  | 0.36  | 0.26  | 0.39  | 0.93  | 0.91  | 0.90  | 0.95  | 0.77  | 0.96  | 0.92  | 1.02  |
| H2O\* | 3.38  | 3.41  | 3.42  | 3.44  | 3.40  | 3.20  | 3.17  | 3.18  | 3.17  | 3.28  | 3.19  | 3.21  | 3.19  |
| B2O3\* | 10.37  | 10.35  | 10.41  | 10.32  | 10.38  | 10.55  | 10.45  | 10.46  | 10.49  | 10.56  | 10.57  | 10.58  | 10.66  |
| Li2O\* | 0.63  | 0.52  | 0.46  | 0.48  | 0.42  | 1.20  | 1.12  | 1.20  | 1.17  | 1.17  | 1.15  | 1.18  | 1.12  |
| O=F | 0.18  | 0.14  | 0.15  | 0.11  | 0.16  | 0.39  | 0.38  | 0.38  | 0.40  | 0.32  | 0.40  | 0.39  | 0.43  |
| Total\* | 99.28  | 99.30  | 99.75  | 98.98  | 99.77  | 99.29  | 98.56  | 98.31  | 98.60  | 99.43  | 99.51  | 99.72  | 100.48  |
|  | 基于31个氧原子计算 |
| T: Si | 5.81  | 5.66  | 5.74  | 5.70  | 5.62  | 5.87  | 5.79  | 5.78  | 5.82  | 5.84  | 5.80  | 5.84  | 5.83  |
| Al | 0.19  | 0.34  | 0.27  | 0.30  | 0.38  | 0.13  | 0.21  | 0.22  | 0.18  | 0.16  | 0.20  | 0.16  | 0.18  |
| B | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  |
| Z: Al | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  |
| Mg | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Fe3+ | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Y: Al | 0.82  | 0.87  | 0.89  | 0.87  | 0.88  | 0.99  | 1.03  | 1.07  | 1.06  | 1.03  | 1.05  | 0.98  | 1.03  |
| Ti | 0.03  | 0.03  | 0.02  | 0.03  | 0.03  | 0.02  | 0.02  | 0.01  | 0.02  | 0.02  | 0.02  | 0.03  | 0.02  |
| V | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.03  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.01  | 0.00  |
| Fe3+ | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Mg | 0.11  | 0.10  | 0.12  | 0.11  | 0.12  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  |
| Mn | 0.03  | 0.04  | 0.03  | 0.03  | 0.04  | 0.04  | 0.05  | 0.04  | 0.05  | 0.05  | 0.05  | 0.04  | 0.05  |
| Fe2+ | 1.59  | 1.61  | 1.63  | 1.63  | 1.65  | 1.12  | 1.15  | 1.07  | 1.08  | 1.13  | 1.12  | 1.15  | 1.16  |
| Li\* | 0.42  | 0.35  | 0.31  | 0.33  | 0.29  | 0.80  | 0.75  | 0.80  | 0.78  | 0.77  | 0.76  | 0.78  | 0.74  |
| ΣY | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  |
| X: Ca | 0.02  | 0.02  | 0.01  | 0.01  | 0.02  | 0.01  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.01  |
| Na | 0.69  | 0.71  | 0.61  | 0.67  | 0.66  | 0.83  | 0.84  | 0.88  | 0.83  | 0.85  | 0.82  | 0.86  | 0.81  |
| K | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| X□ | 0.28  | 0.26  | 0.37  | 0.31  | 0.31  | 0.15  | 0.13  | 0.10  | 0.15  | 0.14  | 0.15  | 0.12  | 0.17  |
| OH | 3.78  | 3.82  | 3.81  | 3.86  | 3.79  | 3.52  | 3.52  | 3.53  | 3.50  | 3.60  | 3.50  | 3.52  | 3.47  |

注：Schorl-黑电气石；Elbaite-锂电气石；根据XY3Z6T6O18(BO3)3V3W的晶体结构式计算H2O、B2O3和Li2O的值(据Henry and Guidotti, 1985)。