**Numerical modeling** **the impacts of increasing groundwater pumping upon discharge decline of the BL Spring located in Xilin Gol League in east Inner Mongolia, China**

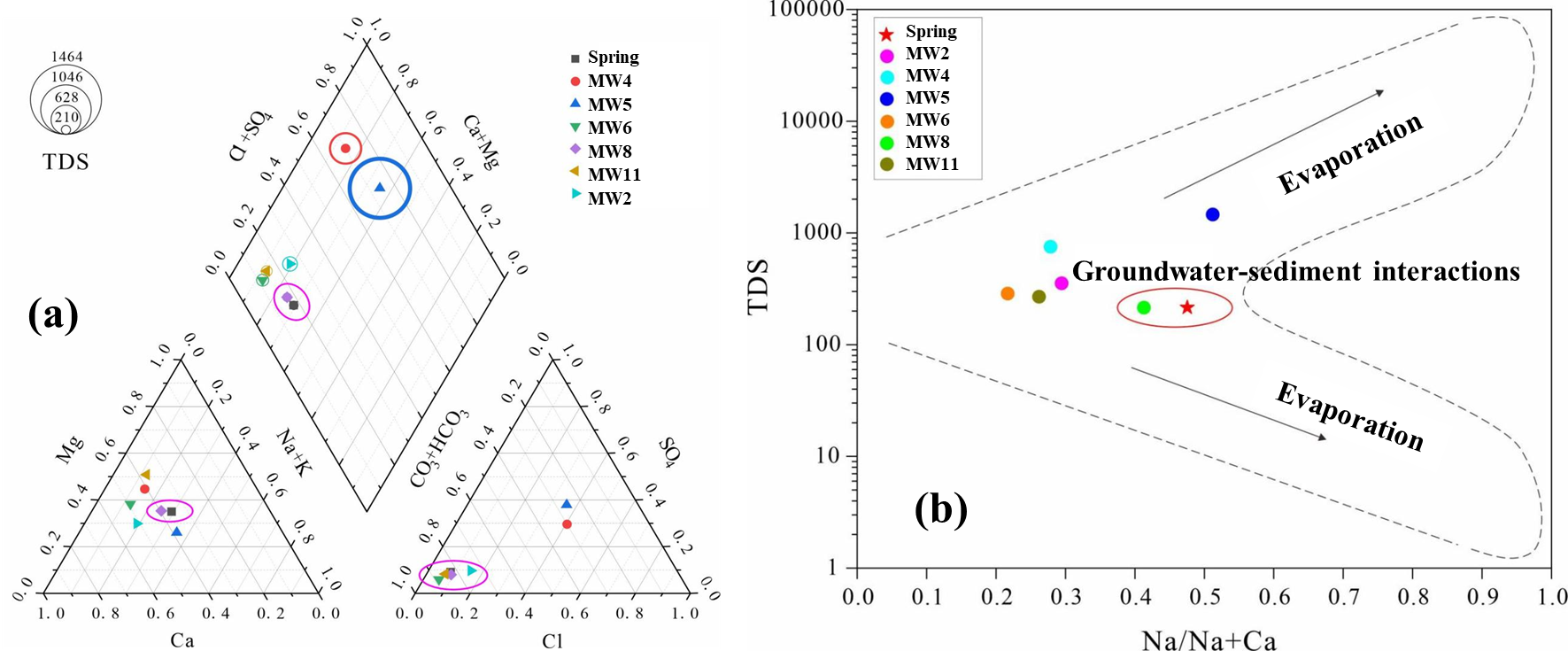
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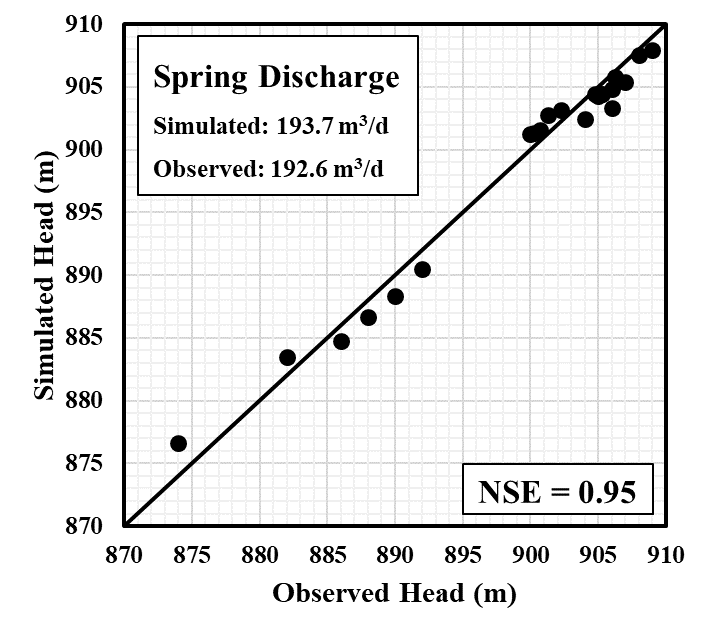
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**1 Supplementary Figures and Tables**

**1.1 Supplementary Figures**

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**Supplementary Figure 1** (a) Piper Diagram; and (b) Gibbs Diagram



**Supplementary Figure 2** Scatter diagram showing the goodness of fit between the simulate and observed groundwater levels during calibration period

**1.2 Supplementary Tables**

**Supplementary Table 1** Hydrogeological parameters of each layer

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Silty sand layer | Clay layer | Fine sand layer |
| Hydraulic conductivity (m/d) | 3.5-6.0 | 0.0001-0.0006 | 0.5-6.0 |
| Porosity (-) | 0.35 | 0.4 | 0.3 |
| Specific yield (-) | 0.004-0.01 | - | - |
| Specific storage (-) | - | - | 0.001-0.005 |

**Supplementary Table 2** Water quality of spring discharge and monitoring wells (unit: mg/L)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| c (mg/L) | Spring | MW2 | MW4 | MW5 | MW6 | MW8 | MW11 |
| K+ | 26.1 | 36.9 | 36.8 | 13.9 | 24 | 14.6 | 26.4 |
| Na+ | 26.1 | 26.4 | 190 | 189 | 13.9 | 24 | 14.6 |
| Ca2+ | 28.8 | 63.2 | 95.5 | 180 | 50.2 | 34.1 | 41.1 |
| Mg2+ | 16.8 | 22.1 | 62.5 | 72.6 | 23.4 | 18.3 | 33.9 |
| CO32- + HCO3- | 189 | 278 | 166 | 380 | 298 | 186 | 276 |
| Cl- | 11.2 | 33 | 130 | 308 | 11.1 | 14 | 12.9 |
| SO42- | 16.4 | 28.6 | 129 | 435 | 15.8 | 16.6 | 21.2 |
| NO3- | 2.35 | 7.63 | 43.6 | 5.13 | 2.01 | 0.849 | 1.54 |
| TDS | 215 | 354 | 751 | 1462 | 286 | 214 | 268 |

**Supplementary Table 3** Descriptions of eight pumping scenarios and simulation results

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Scenario | Active well | Inactive well | Pumping rate (m3/d) | Spring discharge (m3/d) | Spring discharge decline (m3/d) | Reduction ratio (%) |
| 0 | None | #1, #2, #3, #4, #5, #6, #7 | 0 | 201.4 | - | - |
| 1 | #1 | #2, #3, #4, #5, #6, #7 | 6.54 | 200.0 | 1.4 | 0.70 |
| 2 | #2 | #1, #3, #4, #5, #6, #7 | 6.54 | 198.4 | 3.0 | 1.49 |
| 3 | #3 | #1, #2, #4, #5, #6, #7 | 6.54 | 200.4 | 1.0 | 0.50 |
| 4 | #4 | #1, #2, #3, #5, #6, #7 | 6.54 | 201.4 | 0 | 0 |
| 5 | #5 | #1, #2, #3, #4, #6, #7 | 6.54 | 200.9 | 0.5 | 0.25 |
| 6 | #6 | #1, #2, #3, #4, #5, #7 | 6.54 | 200.7 | 0.7 | 0.35 |
| 7 | #7 | #1, #2, #3, #4, #5, #6 | 6.54 | 200.6 | 0.8 | 0.40 |
| 8 | #1, #2, #3, #4, #5, #6, #7 | None | 45.8 | 193.7 | 7.7 | 3.80 |

**Supplementary Table 4** Descriptions of twelve pumping scenarios and simulation results

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Scenario | Total pumping rate (m3/d) | Spring discharge (m3/d) | Spring discharge decline (m3/d) | Reduction ratio (%) |
| 0 | 0 | 201.4 | - | - |
| 8 | 45.8 | 193.7 | 7.7 | 3.8 |
| 9 | 91.6 | 185.9 | 15.5 | 7.7 |
| 10 | 183.2 | 170.2 | 31.2 | 15.5 |
| 11 | 274.8 | 154.5 | 46.9 | 23.3 |
| 12 | 297.7 | 151.1 | 50.3 | 25.0 |
| 13 | 366.4 | 138.9 | 62.5 | 31.0 |
| 14 | 458 | 123.2 | 78.2 | 38.8 |
| 15 | 586.2 | 100.7 | 100.7 | 50.0 |
| 16 | 687 | 84.0 | 117.4 | 58.3 |
| 17 | 888.5 | 50.4 | 151 | 75.0 |
| 18 | 916 | 45.0 | 156.4 | 77.7 |
| 19 | 1145 | 5.8 | 195.6 | 97.1 |
| 20 | 1176 | 0.0 | 201.4 | 100 |