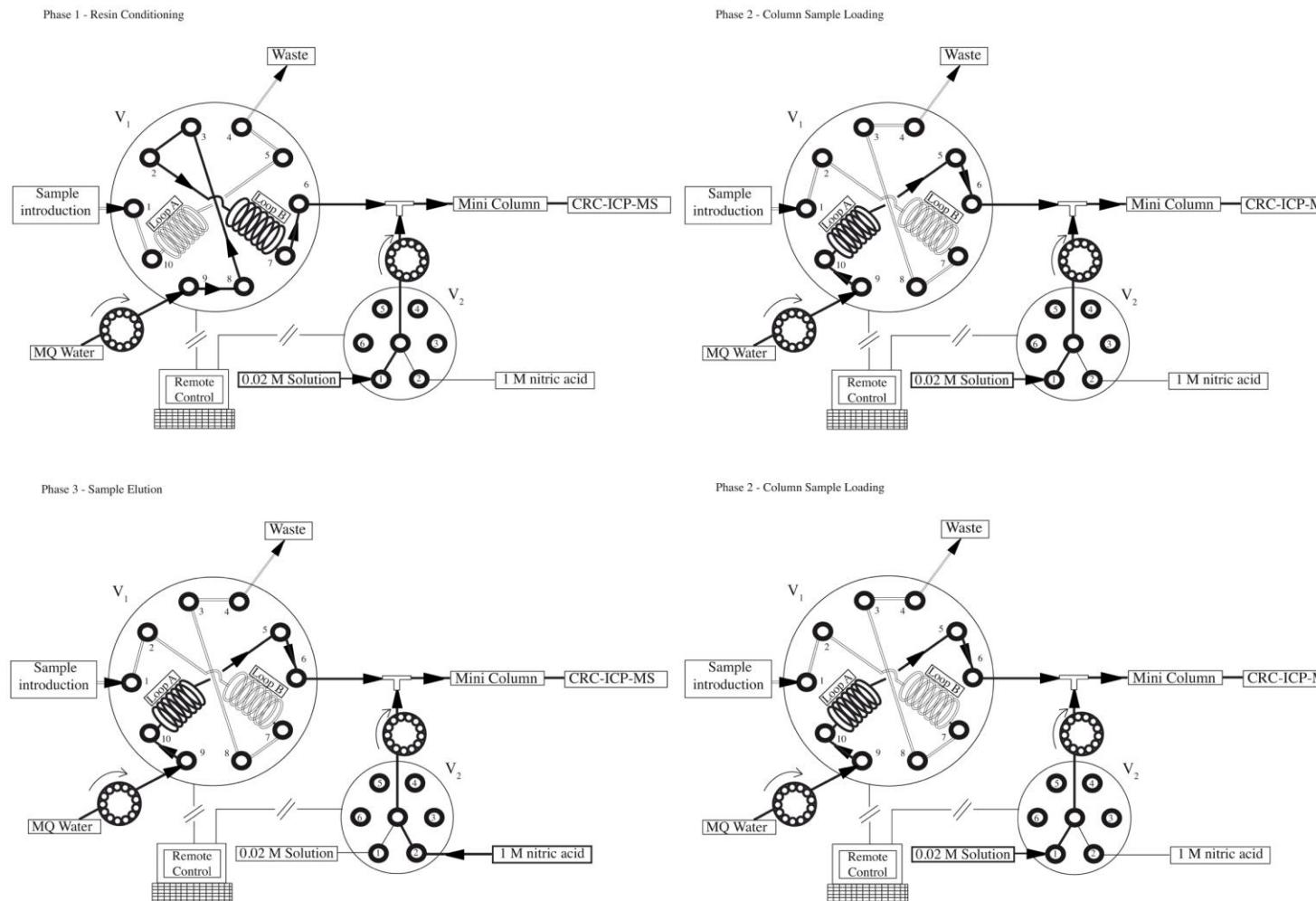


## Supplemental information 1 - Introduction System

Figure. 1



## Supplementary Information

The flow injection manifold system for sample introduction to the CRC-ICP-MS is operated in a sequence consisting of four phases. These are shown in Supplementary Information Figure 1. The following paragraphs present a description of each step.

### *Phase 1 – Resin Conditioning*

The melted ice core sample is loaded into the open loop A in valve 1 ( $V_1$ ) while ultrapure water (UPW) is flushed through loop B and then mixed with 0.02 M  $\text{HNO}_3$  carrier solution from valve 2 ( $V_2$ ) via a T connection, thus producing a pH 2 eluent (pH 1.87 was measured at the exit point). This phase is necessary to condition the resin before the sample is loaded.

### *Phase 2 – Column Sample Loading*

$V_1$  switches position, thus flushing UPW through the charged loop A. The sample is consequently mixed with 0.02 M  $\text{HNO}_3$  solution from  $V_2$  and loaded onto the column. During this phase the oxidized ice core sample fraction is loaded into open loop B.

### *Phase 3 – Sample Elution*

After the sample is completely loaded onto the column,  $V_2$  switches so a 1M  $\text{HNO}_3$  solution is mixed with the UPW stream. The resulting 0.5 M  $\text{HNO}_3$  eluent is suitable for the complete removal of  $\text{Fe}^{3+}$  from the resin.

### *Phase 4 – Standby condition*

Following elution of the sample,  $V_2$  switches back to 0.02 M  $\text{HNO}_3$  carrier solution, thereby conditioning the column resin in preparation for the next sample. Effectively, this phase is identical to phase 1 except that the opposing loop (A instead of B) now contains the sample. Once the measurement by CRC-ICP-MS is completed,  $V_1$  can be switched, thus initiating a new sequence.