Supplemental Data

Microdevice details

The MOA instrument was designed to utilize a four-layer hybrid microchip that has been described in great detail in the references indicated in the main text. This work was conducted using a simpler two-layer test chip that includes only the electrophoresis channels. The mask design is shown in Figure S01. The electrophoresis channels are shown in red and are 23.4 cm long and 100 μm wide. The cross channel is located 0.6 cm from the anode end of the channel. The detector is positioned 0.5 cm from the cathode end of the channel. The turn sections are tapered to 55 μm with 2:1 aspect ratio entrance and exit triangle transitions. Features in blue include alignment marks for automated drilling, cartoon channel identifiers, and features to vent trapped air and thus aid in bonding. The entire design is etched to 25 μm depth on a 100 mm diameter borofloat glass wafer.

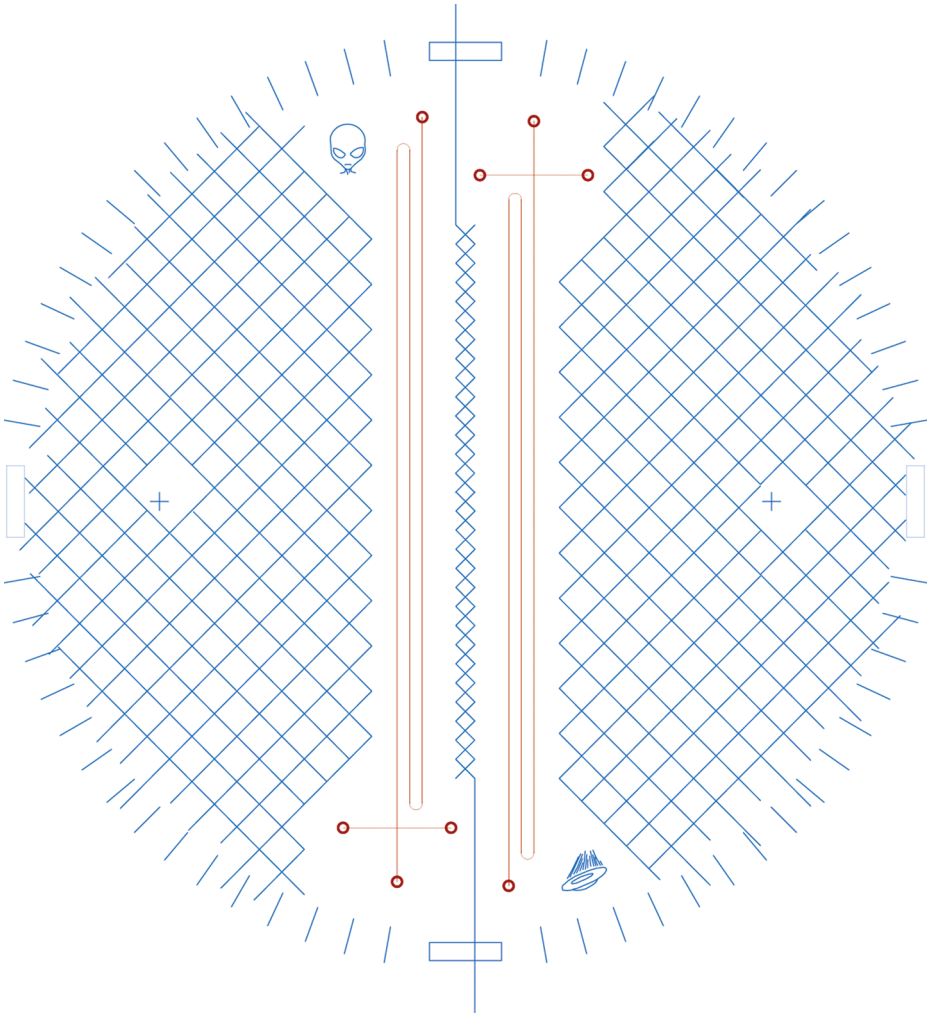

FIG. S01. MOA test chip mask design. Electrophoresis channels are in red. The blue features include alignment marks for automated drilling, cartoon identifiers for ease of chip and channel identification, and vents to aid in escape of trapped air during bonding.

TABLE S01. INITIAL BUFFER SCREENING EXPERIMENTAL RESULTS

			Analysis Buffer							
			[Borate]					[Phosphate]		
			5 mM	10 mM	20 mM	50 mM	75 mM	5 mM	10 mM	20 mM
Sample Buffer	[Borate]	5 mM								
		10 mM								
		20 mM								
		50 mM								
		75 mM								
		100 mM								
	[Phosphate]	5 mM	Experiments not conducted.							
		10 mM								
		20 mM								
		50 mM								
		100 mM								

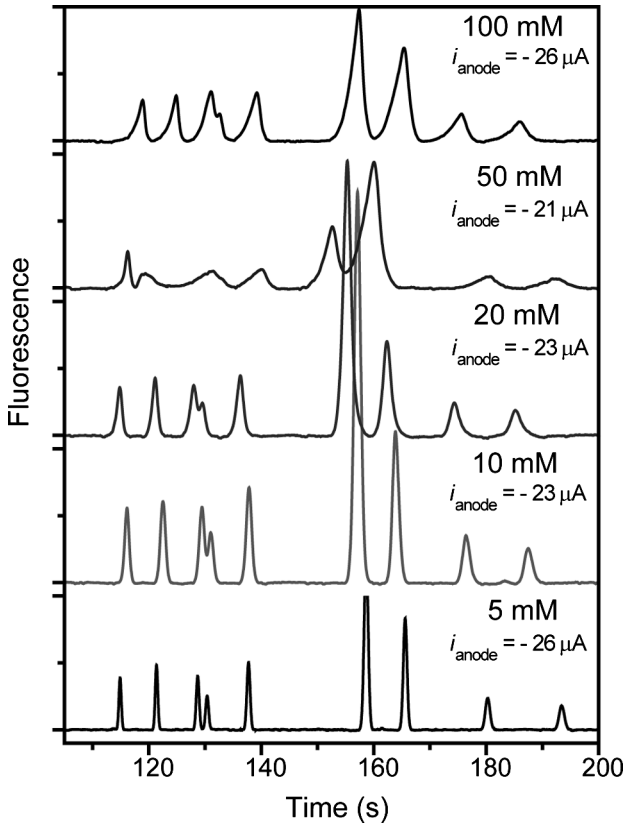

FIG. S02. Electropherograms of an amino acid standard containing the indicated concentration of phosphate buffer in the sample. All separations analyzed with 5 m*M* phosphate in the separation column.

Additional experiments

Initial buffer selection. A screening run was conducted of the buffer systems shown in the matrix in Table S01. Cells are shaded according to the quality of separation achieved with the indicated buffer system. Green represents a high-quality separation, defined by baseline or better resolution of the serine and alanine peaks. White represents a medium-quality separation with resolution of the serine and alanine peaks between 0.5 and 1. Yellow represents a low-quality separation, defined by an inability to differentiate serine and alanine peaks or run-to-run inconsistency in resolution of these peaks. Red cells represent buffer combinations that resulted in high enough separation currents to cause electrical shorts in the instrument. An example set of electropherograms resulting from this screen is shown Figure S02. We chose the four buffer systems that showed high separation quality and were likely to span a range of tolerance to salt added to the sample buffer for the further optimization experimentation conducted.

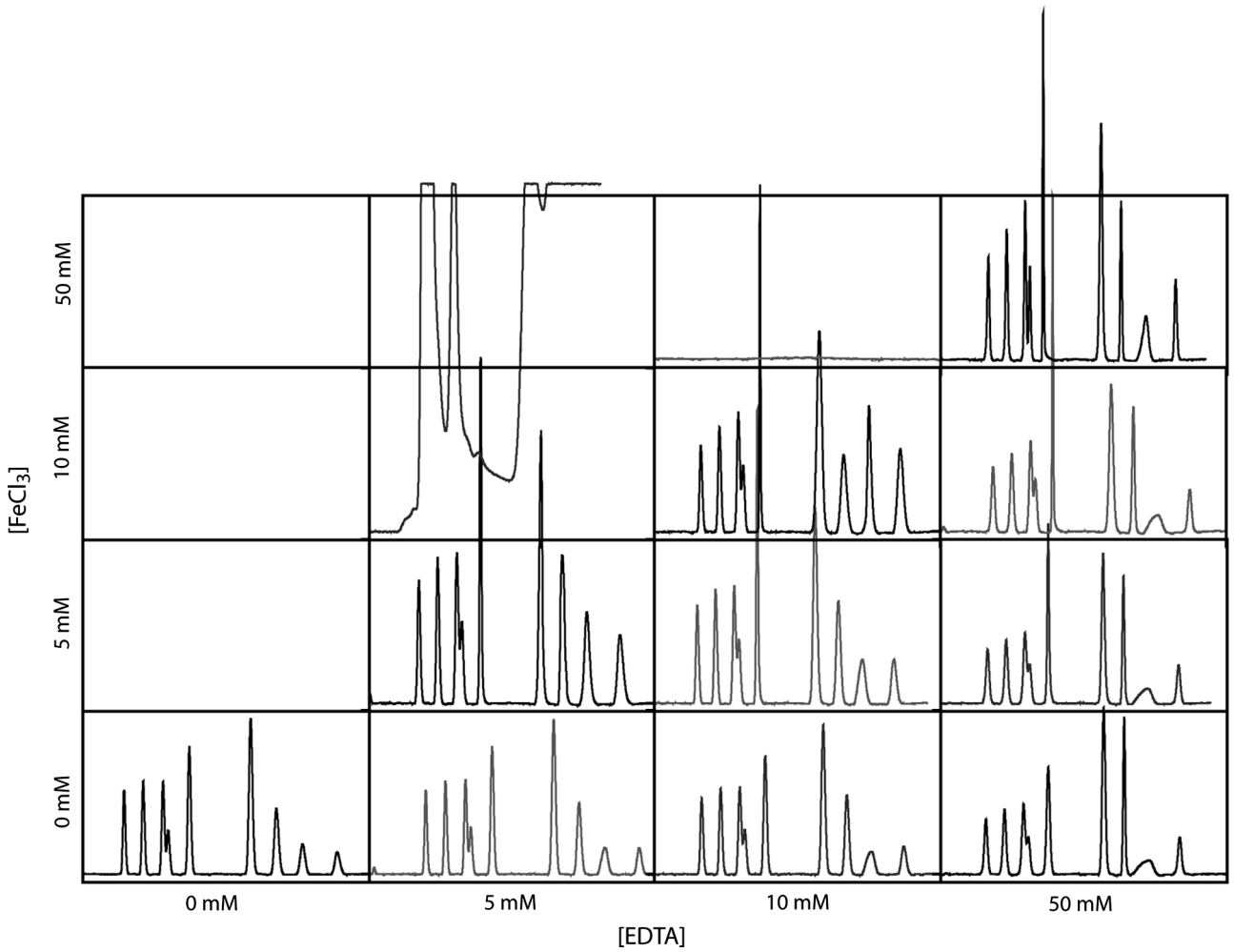

FIG. S03. Electropherograms of an amino standard containing various concentrations of EDTA and $FeCl_3$. Sample and analysis buffer is 30 m*M* borate pH 9.5.

Effects of sample EDTA. In addition to the experiments optimizing EDTA concentration for various $MgCl_2$ concentrations discussed in the main manuscript, we conducted a similar study using $FeCl_3$. Electropherograms resulting from this study are shown in Figure S03. Where the EDTA concentration was less than the $FeCl_3$ concentration, there is either no signal or highly unrepeatable anomalous results.

EDTA effects on labeling. See supplemental data Fig. S04.

Saline Valley sample SV07-4. See supplemental data Figs. S05 and S06.

Río Tinto sample KF03-136. See supplemental data Figs. S07 and S08.

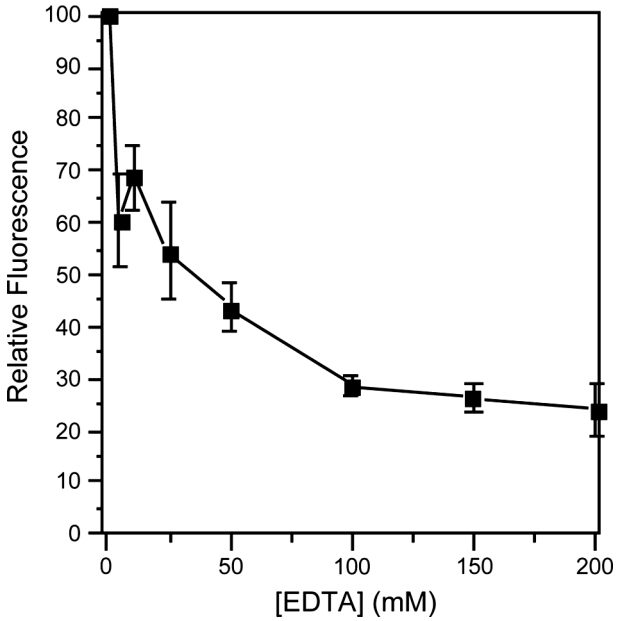

FIG. S04. Effects of EDTA on fluorescamine labeling efficiency of glycine. Labeling was performed in buffers containing 30 m*M* borate buffer, pH 9.5, and the indicated concentration of EDTA and 2.7 μM fluorescamine. Fluorescence was taken after a 10-minute reaction time and shown as a percentage of the fluorescence of samples with no EDTA.

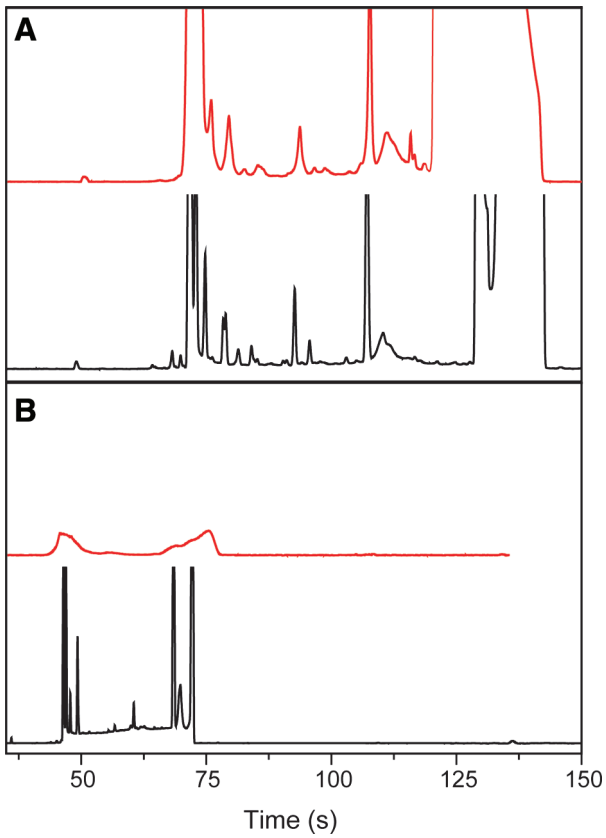

FIG. S05. Electropherograms of Pacific Blue labeled Saline Valley sample SV07-4 (top, red) and its associated blank (bottom, black). (**A**) Separation and labeling buffer are both 4 m*M* carbonate, pH 8.5. (**B**) Separation and labeling buffer are both 30 m*M* borate pH 9.5.

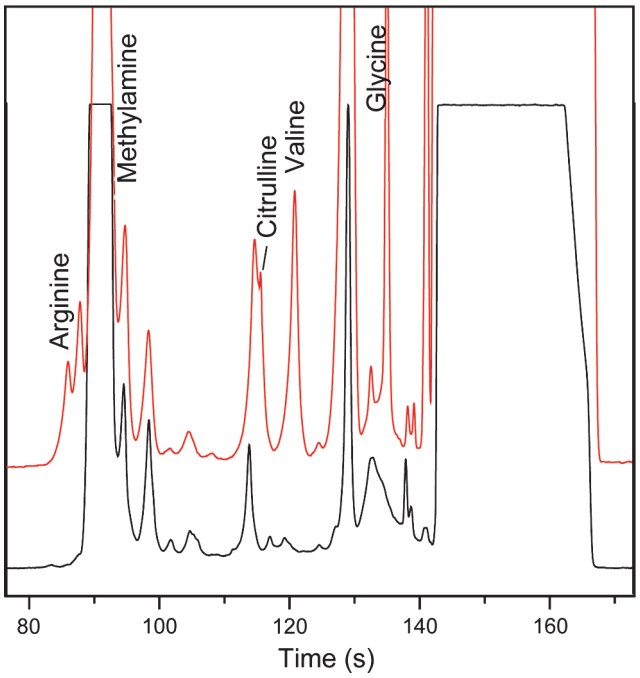

FIG. S06. Electropherograms of Pacific Blue labeled Saline Valley sample SV07-4 (black, bottom) and Pacific Blue Saline Valley sample SV07-4 (red, top) spiked with arginine, methylamine, citrulline, valine, and glycine.

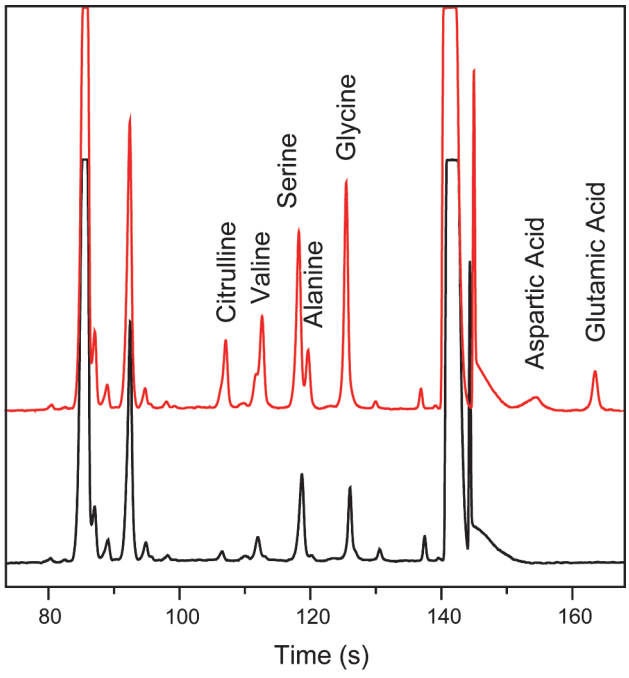

FIG. S08. Electropherograms of Pacific Blue labeled Rio Tinto sample KF03-136 (black, bottom) and Pacific Blue Rio Tinto sample KF03-136 (red, top) spiked with citrulline, valine, serine, alanine, glycine, aspartic acid, and glutamic acid.

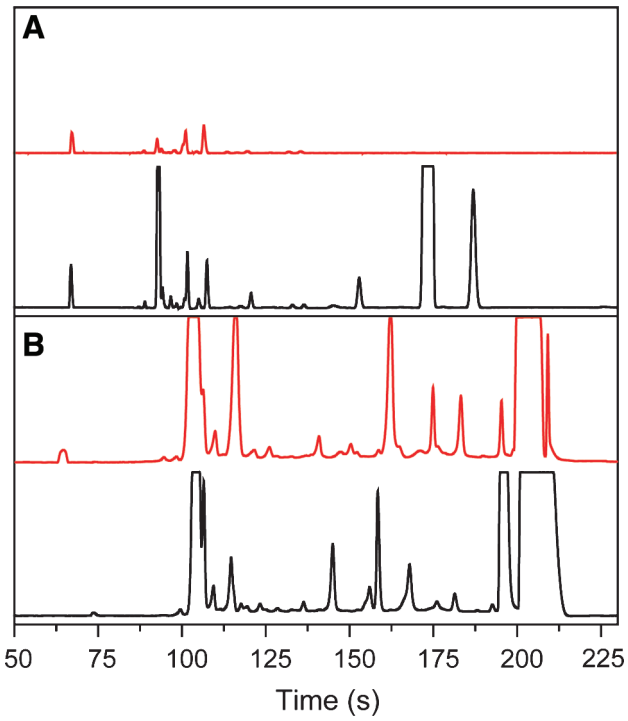

FIG. S07. Electropherograms of Pacific Blue labeled Rio Tinto sample KF03-136 (top, red) and its associated procedural blank (bottom, black). (**A**) Separation and labeling buffer are both 4 m*M* carbonate, pH 8.5. (**B**) Separation channel contains 30 m*M* borate, pH 9.5. The sample and blank were diluted with 30 m*M* borate before labeling, then brought to a final sample buffer composition of 30 m*M* borate, 50 m*M* EDTA for injection.