Characterization of a Soft Ionization by Chemical Reaction in Transfer Ion Source Hyphenated with Supercritical Fluid Chromatography Tandem Mass Spectrometry

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INTRODUCTION

- Supercritical fluid benefits include green technology, low costs, and less toxic reagents when incorporated in separation techniques.
  - SFC has high diffusivity and low viscosity
- Mass spectrometry sensitivity, selectivity, and accuracy depend on the ionization source.
- Atmospheric pressure ionization techniques such as electrospray ionization (ESI), atmospheric pressure chemical ionization (APCI), and atmospheric pressure photoionization (APPI) are more sensitive than vacuum techniques.
- Dielectric barrier discharge ionization (DBDI) generates a low-temperature plasma at atmospheric pressure to ionize samples.
  - DBDI can handle larger molecules and exhibit similar sensitivity to API techniques

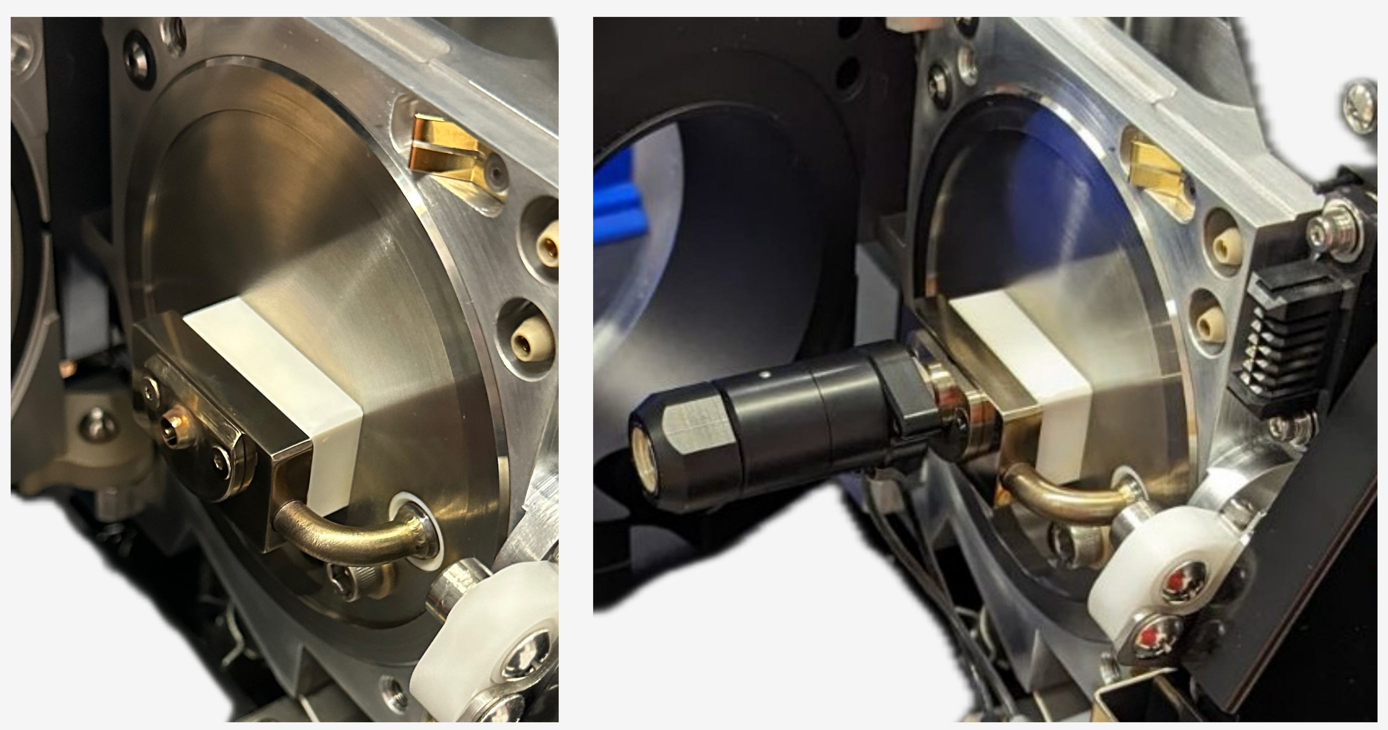

Figure 1. Comparison of standard LC-8050 source (left) and SICRIT source (right)

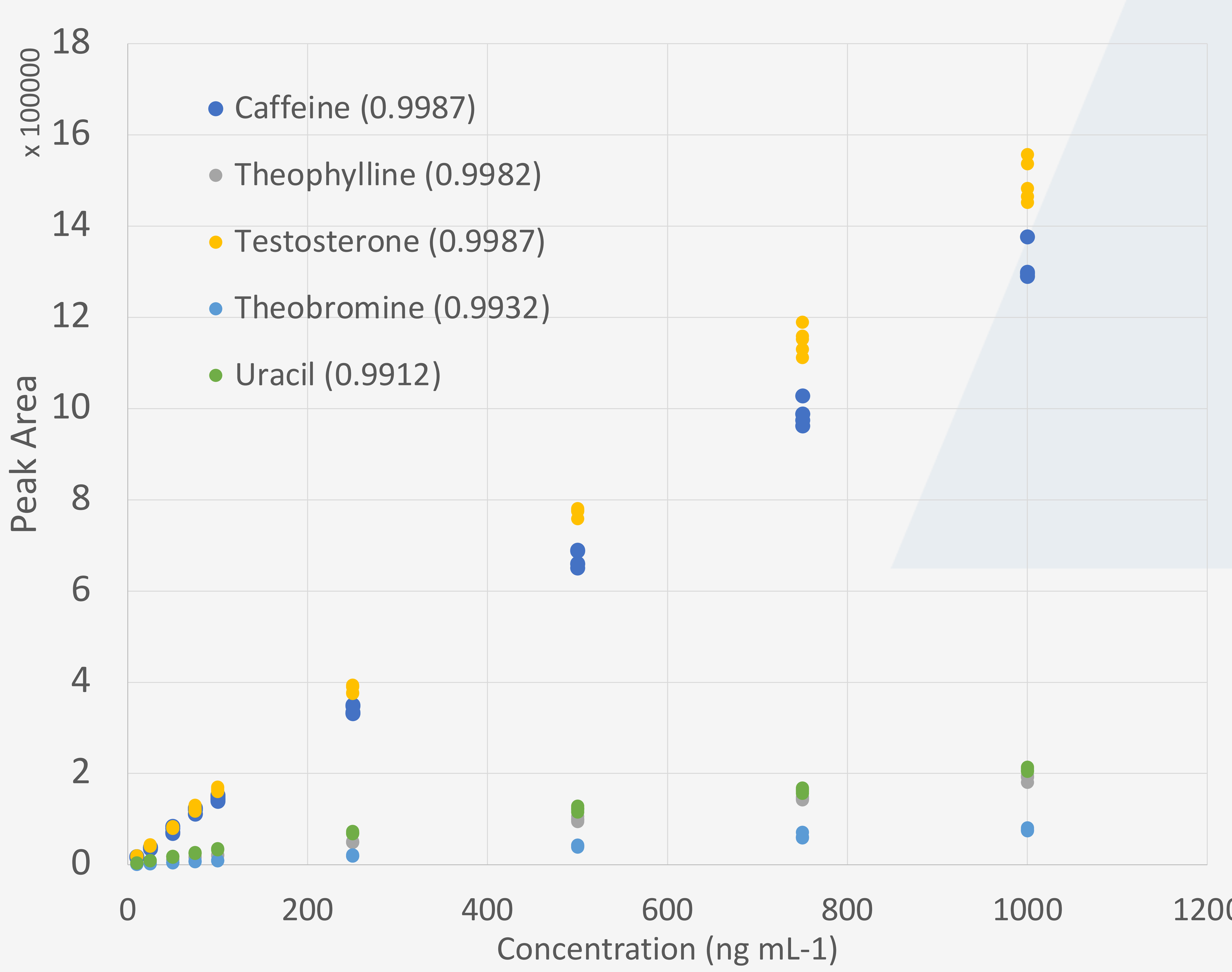

Figure 2. Linear regression of standard mix from 10 to 1000 ng mL^{-1}

MATERIALS AND METHODS

Materials:

- Mobile phase: Supercritical CO_2 & Methanol
- Chromatographic Column: Restek Raptor HILIC-Si (150 x 4.6 mm, 5 µm)
- Standards Used: Caffeine, Uracil, Theophylline, Theobromine, Testosterone

Instrumentation:

- Pumps: LC-ADsf/LC-30AD
- SFC-30A Backpressure Regulator: 150 bar and 50 °C
- LCMS – 8050, triple quadrupole
- Column oven: CTO-20AC (set to 40 °C)
- SICRIT assembly: 1600 V and 15 kHz

Methods:

- 5 µL injection of standards mix
- Isocratic mobile phase composition set to 5%, 10%, 20%, 30%, 40%
- Standards mix were injected in quadruplicate under the various isocratic conditions
- Analytes were evaluated for peak area detected by the mass spectrometer

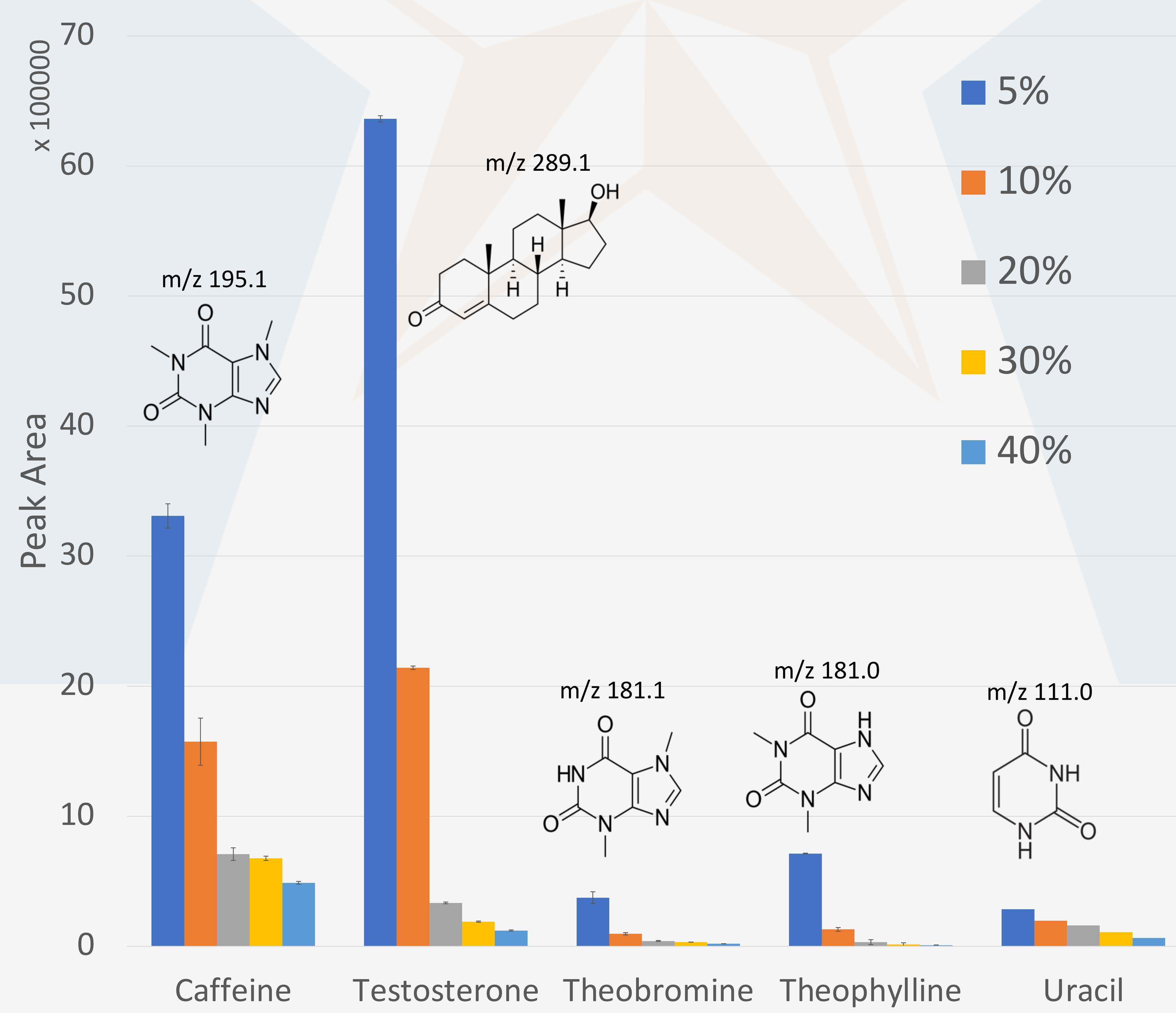

Figure 3. Methanol concentration effects on the peak area of standard compounds. Analyte structure and precursor mass-to-charge $[M+H]^+$ located peak area bars.

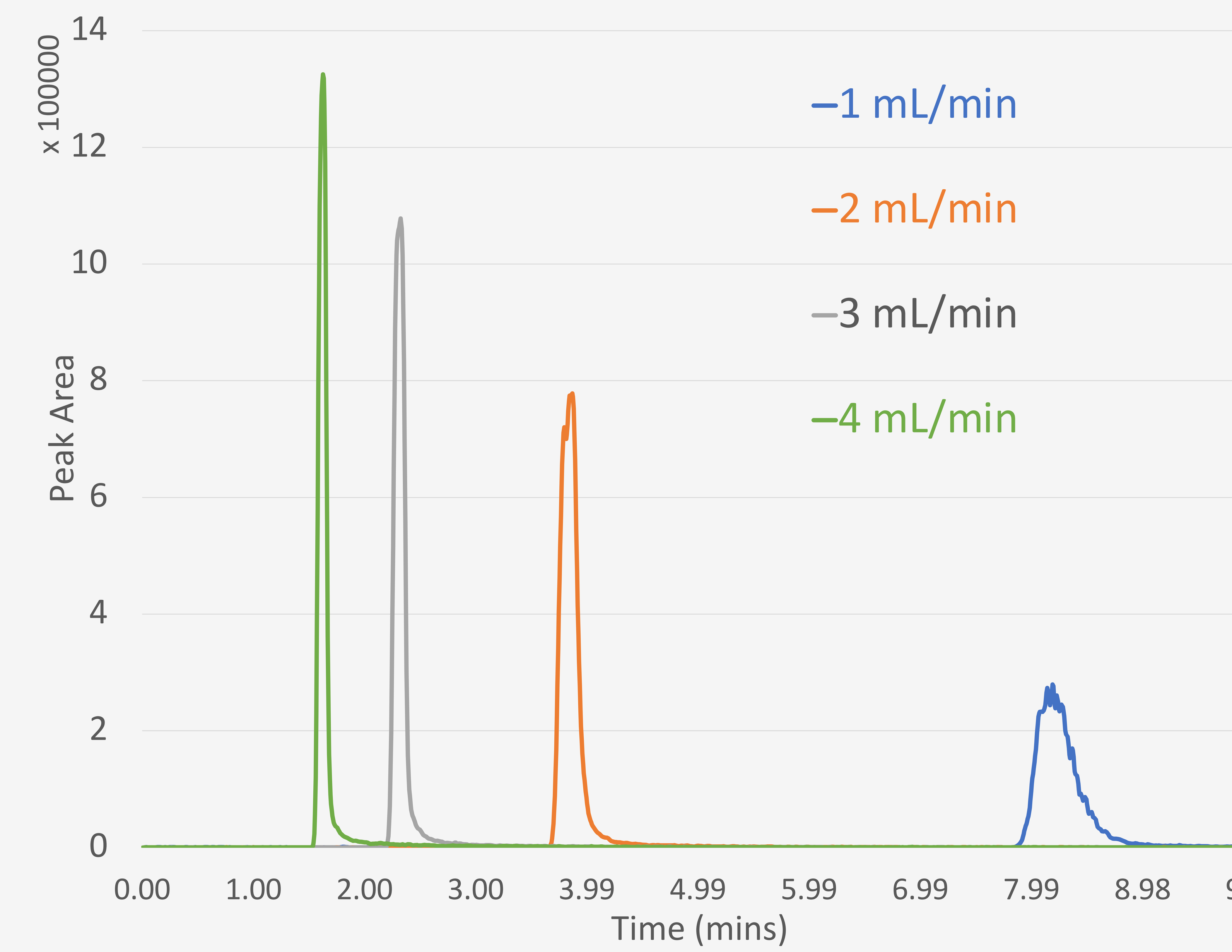

Figure 4. Testosterone effects at methanol concentration of 5% at flow rates to show effects on peak area and chromatogram

RESULTS

- Linear studies were conducted from 10 to 1000 ng mL^{-1}, and the correlation of the standard mix was > 0.99 for all analytes tested.
- Increasing methanol concentrations from 5% to 40% decreases all analytes' peak areas.
  - Caffeine loss – 85%, Testosterone – 98%, Theobromine – 95%, Theophylline – 99%, Uracil – 77%

CONCLUSION

- The first application of DBDI source with SFC-MS instrumentation
- This study shows the potential applications of analysis of both polar and nonpolar compounds with the SICRIT source
- Future applications of this source with larger and nonpolar compounds that are not ionizable with traditional API sources
- Expanded studies on linearity and sensitivity of compounds which are difficult to detect using typical techniques

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