

# COMPARISON OF THE AQUEOUS/ORGANIC PHASE PARTITIONING OF ASTATINE-211 TO HEAVY METALS AND HALIDES IN A HYDROCHLORIC ACID/ETHER/SODIUM HYDROXIDE SYSTEM

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Astatine ( $^{211}\text{At}$ ) is emerging as an attractive option for use as an oncological therapeutic radioisotope due to the short half-life (7.21 h), high energy  $\alpha$  decays (5.87 and 7.45 MeV), and lack of long-lived  $\alpha$ -emitting daughter radionuclides. Historically, the two most prevalent methods to remove  $^{211}\text{At}$  from the Bi target metal were found to be either a dry distillation of  $^{211}\text{At}$  from molten Bi into a vapor trap or a Bi dissolution scheme followed by liquid/liquid (L/L) extraction to separate the solubilized  $^{211}\text{At}$  from Bi. The University of Washington (UW) has shown that L/L extraction approach can be used to reproducibly produce high purity  $^{211}\text{At}$  with good yields.

The UW designed L/L extraction process is as follows: 1) Bismuth nitrate salts, containing  $^{211}\text{At}$ , are dissolved in 8 M HCl, 2)  $^{211}\text{At}$  is extracted into diisopropyl ether (DIPE), 3) the DIPE solution is washed using 8 M HCl, and 4)  $^{211}\text{At}$  is back extracted into an aqueous solution using 4 M NaOH. Despite the experimental success of this process, little is understood concerning the speciation and mechanism of partitioning for  $^{211}\text{At}$  in the L/L extraction.

Previous studies, supported by current PNNL research, have suggested that the  $^{211}\text{At}$  extraction is dependent on the feed stock acid concentration, molar ratios of the aqueous and organic phases, and the ability of the organic solvent to act as a Brønsted acid, thus resulting in a cationic species. PNNL has performed the HCl/DIPE/NaOH extractions utilizing  $^{211}\text{At}$  as well as a variety of metal and halide radiotracers and spectroscopic techniques to evaluate the L/L extraction process in detail. Findings to date will be presented.