**Supporting Fig. S1.** Average ROI-based two-pool, MT-fitted results (black dashed lines), experimental data (black asterisks), and five-pool fitted results (red solid lines) obtained from the tumor and normal tissue at two RF saturation power levels (n = 6). The two-pool conventional MT model consisted of bulk water protons and semi-solid macromolecular protons. The five-pool model consisted of bulk water protons, semi-solid macromolecular protons, amide protons, CEST@2ppm protons, and NOE-related protons.
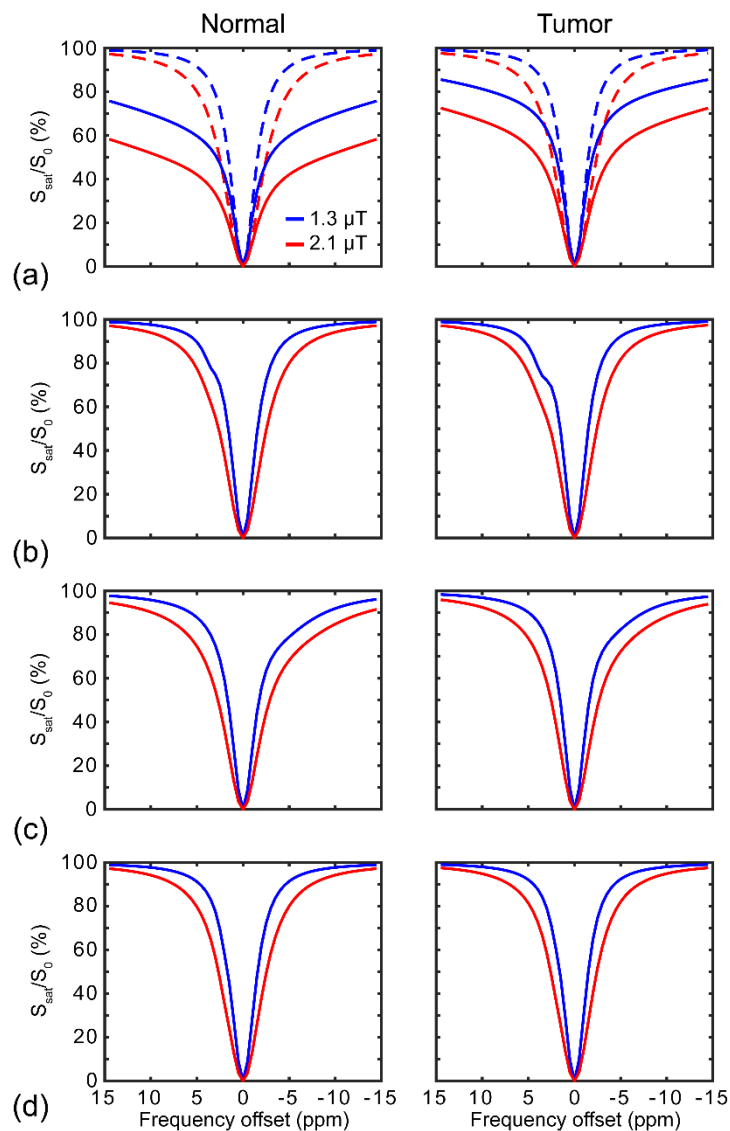
Supporting Fig. S2. Simulated Z-spectra of normal tissue and the brain-tumor tissue at 1.3 μT (blue) and 2.1 μT (red). (a): water (dash) and MTC (solid) models. (b): Two-pool APT models (bulk water and amide protons). (c): Two-pool NOE models (bulk water and NOE-related protons). (d): Two-pool CEST@2ppm models (bulk water and CEST@2ppm protons).
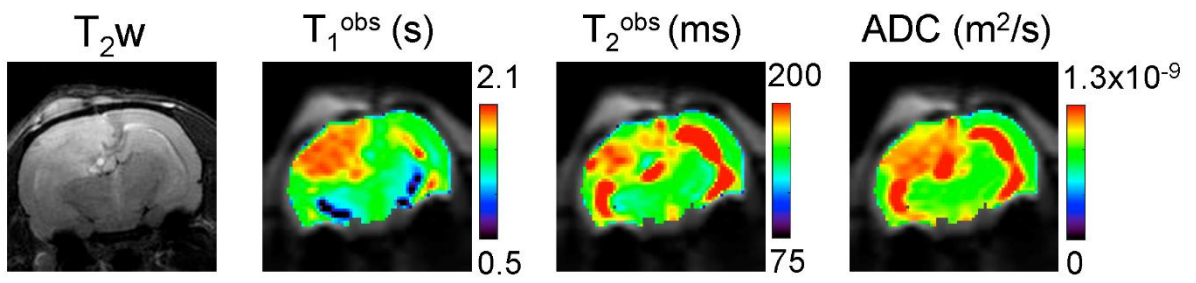
Supporting Fig. S3. T_2-weighted, T_1^{obs}, T_2^{obs}, ADC maps for a representative tumor-bearing rat (Fig. 9).