Without access to GPS and high-quality visual landmarks, many autonomous underwater vehicles (AUV) face a fundamental navigation vs. cost tradeoff: advanced navigation systems that might include an INS, Doppler velocity, or long-baseline acoustics are expensive. Supporting low-cost operations, this work focuses on collaborative positioning for a team of AUV’s, given a bathymetric terrain map, and only an altimeter and acoustic modem on each vehicle. The joint localization is performed via decentralized particle filtering, where we extend the usual measurement model to allow received information to modulate the importance function. We investigate the impact on performance of sensor noise, communication interval and number of vehicles. Results are shown for bathymetry maps near St. John’s Island, Singapore, and for the Charles River Basin, Boston. In the second case, we ran our algorithm with physical measurements from actual vehicles executing trajectories.