The thermodynamics is essential for understanding the nature of molecules, in particular biological macromolecules in solution. However, contrary to well-developed time-resolved spectroscopy, it has been very difficult to reveal reaction dynamics by using thermodynamic properties, because time-resolved detection of these properties is still very difficult. Recently our group has been working on time-resolved thermodynamics for a variety of photochemical processes in the nanosecond time range. We used a pulsed laser induced transient grating (TG) for quantitative measurements in the time domain. Here we will report on the compressibility of short lived intermediate species of phototropin 1 LOV2-linker. Phototropin is a blue light sensor protein and phot1LOV2-linker is a part of this protein. The compressibilities of intermediate species were measured in the time-domain by the TG and transient lens methods with a high pressure optical cell. The yield of covalent bond formation between the chromophore and a Cys residue relative to that at 0.1 MPa decreased very slightly with increasing pressure. The fraction of the reactive species that yields the intermediate decreased almost proportionally with pressure (0.1–200 MPa), but this change was not significant. In contrast to the rather insensitive pressure dependence of the reaction yield, the volume change associated with the reaction was pressure sensitive. Combining these data, the compressibility changes for the short lived intermediate and the final product formation were determined. The compressibility of the initial intermediate was found to increase compared with the ground state, and the compressibility decreased during the transition from the initial intermediate to the product. The compressibility change is discussed in terms of changes in the flexibility.