A theory is proposed, which predicts the reduction of the number of soft localized excitations in glasses under pressure. This occurs because the majority of these excitations have a negative cubic anharmonicity. For that reason the applied pressure predominantly transforms soft localized vibrational modes and soft (low-energy) tunneling two-level systems into higher-energy two-level systems, whereas the simultaneous reverse transformations of available non-soft two-level systems into soft localized modes and into soft two-level systems are less numerous. The experimentally observed pressure-induced narrowing of spectral holes [1,2] and the suppression of the low-frequency part of the phonon sideband in the absorption spectrum is in agreement with our theory.