Matrices with Few Nonzero Principal Minors

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For an $n$ by $n$ complex matrix $A$, let

$$V_A = \{(d_1, \ldots, d_n) \mid (\text{diag}(d_1, \ldots, d_n)A)^n = 0\}.$$ 

We say that $A$ is quasi-D-nilpotent if $\dim V_A = n - 1$ as an algebraic variety. It is proved that a quasi-D-nilpotent matrix has very few nonzero principal minors. We determine irreducible quasi-D-nilpotent matrices and the Frobenius normal forms of quasi-D-nilpotent matrices with respect to permutation similarity when $V_A$ is the set of zeros of a homogeneous polynomial of degree at most 2. This is a joint with Yan Tian and Yueyue Li.