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We have produced a transgenic strain of mouse with a highly restricted B cell repertoire that can respond only to the synthetic antigen polyvinyl pyrrolidinone, a thymus-independent type 2 (TI-2) antigen with no known cross-reactivity. This mouse strain (named PV1TgL) serves as a unique *in vivo* model system for studying naïve B lymphocytes and the effects of TI-2 antigen exposure on B cell development and function. B cell phenotype and serology were analyzed in adult PV1TgL mice both prior to exposure to antigen and after adult immunization with PVP. The peripheral lymphoid organs of the pre-immune mouse are almost entirely devoid of B cells, due in part to impaired B cell development in the bone marrow at or before the pre-B cell stage. The few B cells found in the spleen bear the surface phenotype of transitional-2 immature B cells with some characteristics of marginal zone cells. Serum IgM levels in the pre-immune PV1TgL are low but significant. After immunization with 1ug PVP, a new population of B cells with a classical B-1 phenotype appears rapidly and transiently, first in the spleen and later in the peritoneal cavity. Serum IgM levels increase dramatically after PVP immunization, peaking 4 to 5 days post-immunization. These data demonstrate both the antigen dependence of splenic B cell maturation and the ability of a TI-2 antigen to induce both antibody secretion and a B-1 phenotype in adult B cells.