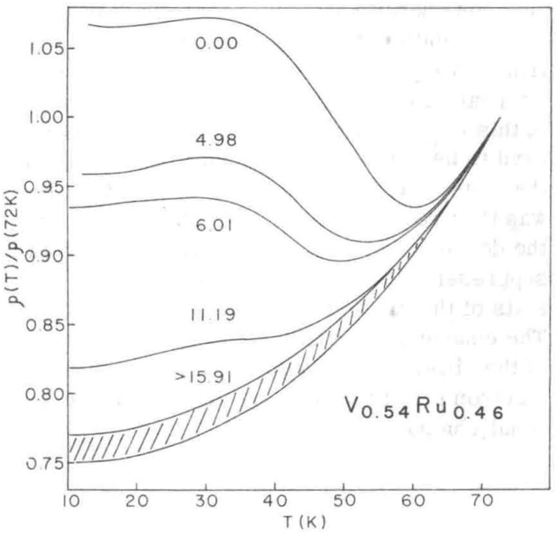

FIG. 2. Effect of pressure on the normalized resistivity of $V_{0.54}Ru_{0.46}$. The numbers denote the pressure in kbar.

$\Delta\rho_n(P, C)$ may be most conveniently taken as $\rho_n(P,C) - \rho_n(15, C)$ for $C = 46$, and $\rho_n(P, C) - \rho_n(0, 45)$ for $C = 47$ and 48. To be consistent, all $\Delta\rho_n$'s have been evaluated at 10 K, where ρ_n varies with temperature slowly. The results are shown in Fig. 3 where $\Delta\rho_n(P)/\Delta\rho_n(0)$ is plotted against P. For $C = 46$ a critical pressure, $P_k = (14 \pm 2)$ kbar, is obtained for the complete suppression of $\Delta\rho_n$, which we associate with the stabilization of the cubic phase. From an examination of Fig. 2 it can be seen that the indications are that T_L follows a strongly nonlinear variation with pressure, particularly close to P_k. However, we are unable to distinguish whether T_L actually falls to zero at P_k or whether the transformation is suppressed before this occurs. For $C = 47$ and 48, the extrapolated P_k is much higher than 21 kbar, the maximum hydrostatic pressure available in the present investigation. It is evident from Fig. 3 that P_k increases rapidly with C.

The T_c of the sample with $C = 46$ was determined resistively up to 21 kbar, and the variation is shown in Fig. 4. The vertical bar attached to each point represents the transition width and the number indicates the sequential order in which the data were taken. When detected inductively the superconducting transition is wider than that seen resistively and shows a small step below 4 K, suggesting the inclusion of small amount of a second phase (see Ref. 3 for a comprehensive description of the inductive transition curves). However, the bulk of the inductive transition agrees with the resistive one. T_c initially increases linearly with pressure with $\partial T_c/\partial P = (9.1 \pm 0.3)\times 10^{-6}$ Kbar^{-1}, but an abrupt change of slope occurs at (14 ± 2) kbar, coincident with P_k, the critical pressure above which the structural transformation is prohibited. This observation confirms the earlier assumption[3] that such changes in the rate of change of T_c with pressure are associated with the suppression of the cubic to tetragonal transformation.

Our present value for the initial $\partial T_c/\partial P$ for $C = 46$ is smaller, by about a factor of 2, than that obtained from the previous independent measurements[3] made on a different sample of this nominal composition. However, in view of the large variation of $\partial T_c/\partial P$ with C which occurs near $C_k = 45.5$, we would attribute the difference to a possible small difference in C.

Based on the general occurrence of elastic anomalies in high-T_c superconductors, Testardi[12] has suggested that a high T_c is associated with a lattice softness. According to this suggestion the highest T_c should occur when the lattice softness is at a maximum. Thus, if $|T - T_L|^{-1}$ is adopted as a measure of the lattice softness at temperature T, then it would be anticipated that T_c would reach a maximum as $T_c \rightarrow T_L$. The observation of the T_c peak at

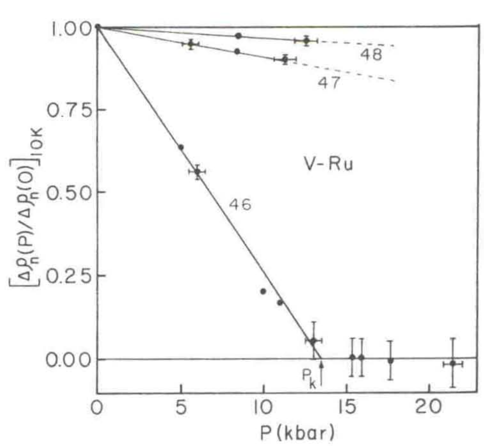

FIG. 3. Pressure dependence of $\Delta\rho_n$. The numbers represent the atomic percent of Ru.

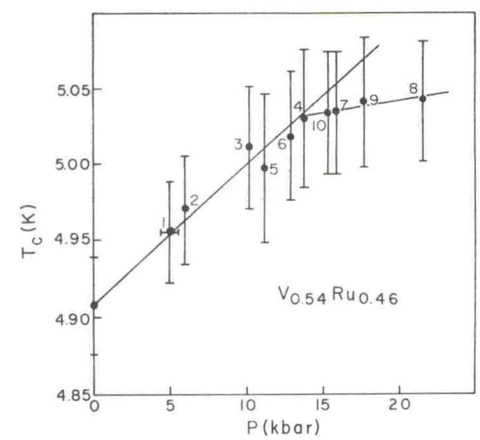

FIG. 4. Pressure dependence of T_c for $V_{0.54}Ru_{0.46}$.

C_k seemed to be consistent with this explanation.[5] However, the expected T_c maximum at a pressure close to P_k fails to appear, but instead a continuous increase of T_c with pressure beyond P_k is found, although at a slower rate.

It has been observed[1] that over a narrow temperature region where structural transformation takes place, the electrical resistivity increases sharply and the magnetic susceptibility decreases rapidly upon cooling. In addition, the Sommerfeld coefficient γ of the specific heat peaks,[1,2] at C_k. From these results it was suggested[3,4] that the structural transformation is driven by the excess electron energy associated with a large value of the d-electron density of states $N(0)$ at the Fermi surface for the electron energy spectrum of the cubic phase. The transformation then results in a substantial reduction in $N(0)$, which accounts for the appearance of a γ peak near C_k. The enhanced superconductivity in this compound system near C_k was thus considered to be a direct consequence of the existence of the $N(0)$ peak. The increase of T_c under pressure was then readily accounted for by the increase in the density of states which would result from the suppression of the tetragonal distortion. The results of the present study support this suggestion. The change of $\partial T_c/\partial P$ for $P \geq P_k$ is then a reflection of the difference in the pressure responses of the electron energy spectra between the cubic and tetragonal compounds.

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