First you have to recall, that

$$V = \left(\frac{\partial G}{\partial p}\right)_T$$

So, by differentiating $G(p, T)$ with respect to p we will find equation of state:

$$V = \left(\frac{\partial T^2 \ln(a \cdot p/T)}{\partial p}\right)_T = T^2 \frac{1}{a \cdot p/T} \cdot a/T = \frac{T^2}{p} = V$$

Hence, equation of state is

$$p = \frac{T^2}{V}$$